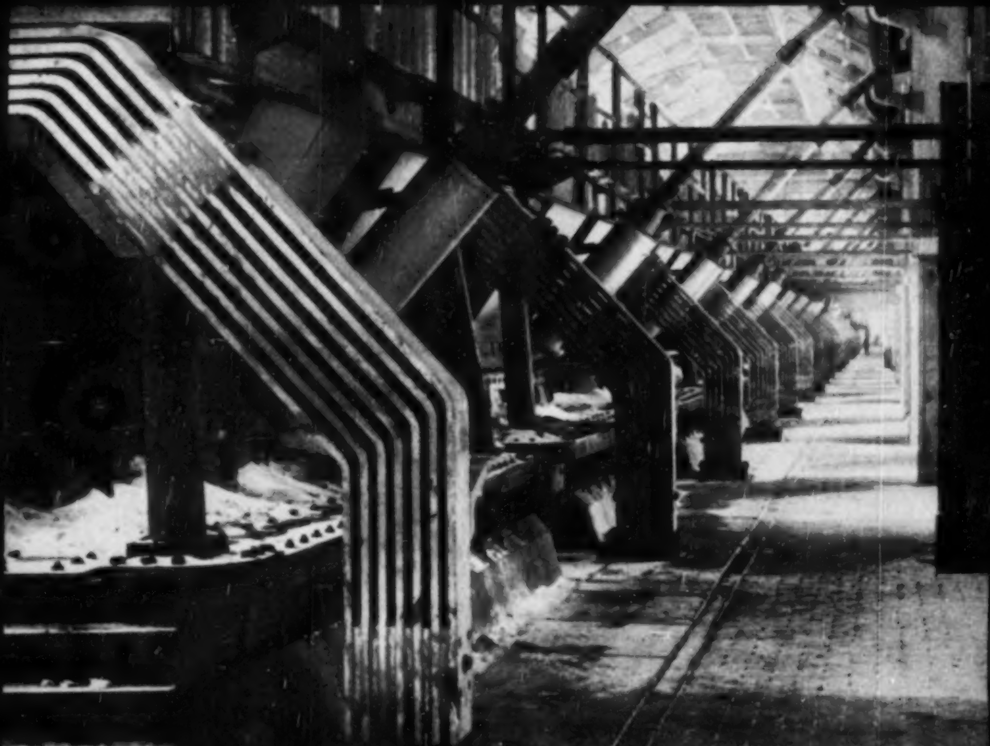
JULY 1950

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING



NATURAL GAS AND A NEW TYPE OF ENGINE MAKE THE POWER FOR THIS ALCOA POT LINE AT POINT COMFORT, P. 102

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Products and literature in this issue are listed on these pages. There are three indexes. (1) editorial items on new equipment, new products, new literature; (2) products advertised; (3) advertisers.

NUMBERS EXPLAINED

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148A	154A	160B	166B	176A	320K	322A	322M	322Z	324I
148B	155A	160C	166C	176B	320L	322B	322N	322AA	324J
148C	155B	162A	166D	320A	320M	322C	322P	322BB	324K
148D	156A	162B	166E	320B	320N	322D	322Q	324A	324L
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PACIFIC PROCESS INDUSTRIES **PPI** *A Section of Chemical Engineering*
JULY 1950 *Vol. 57, No. 7*

PACIFIC EDITION, CHEMICAL ENGINEERING . . . . PACIFIC COAST EDITOR: J. V. Hightower, *San Francisco* . . . . EDITORIAL ASSISTANT: Elizabeth Allen, *San Francisco* . . . . SPECIAL CORRESPONDENTS: James Joseph, *Los Angeles;* Ray Bloomberg, *Seattle* . . . . MANAGING EDITOR: L. B. Pope, *New York*

Container of tracer liquid going into place. Injector puts measured amounts into pipeline.

Standard Puts the Atom in Overalls

Standard Oil Co. of California has put the atom in overalls and has set it to work in a new products pipeline which is being built from the Salt Lake Refining Co. refinery at Salt Lake City to Pasco, Wash. Company officials consider this one of the first commercial uses of atomic energy in American industry.

The process involves the use of a radioactive "tracer" material in successive shipments of different refinery products through the line in order to notify operators when the last of a consignment of one product has reached any given point in the line, which has been completed as far as Boise, Idaho. Use of this radioactive tracer, the identity of which has not been disclosed, is a Standard Oil Co. of California development, and is believed to have wide potentialities in the transmission of other materials. The tracer was produced in the AEC laboratories at Oak Ridge.

Various methods have been applied to keep track of the movement of successive "slugs" of different refinery products moving through pipelines. The problem involved in operating the new Salt Lake City to Pasco line, however, was particularly tough. The line is long—566 mi. It is designed to carry a number of materially differing products ranging from gasoline to fuel oils, and there are many intermediate stations where portions of some products are removed.

With the new method, each time the pumping station at Salt Lake City changes the product being put into the line, a fraction of an ounce of highly diluted tracer material is injected into the line between the products. As the junction of the two products moves through the line, the tracer moves along with it. At any intermediate point on the line where a product may be drawn off to tankage, or at Pasco, electrical instruments utilizing Geiger counters attached to the pipeline respond to the tracer's arrival. An operator therefore knows when one product reaches the cut-off valves, and he then switches the stream of new product into the proper tank.

Tests have proved that use of the tracer involves no hazard whatever in handling, using or storing products that have passed through the line. The tracer is not only present in extremely small amounts but also quickly falls off in radioactivity, which eventually disappears altogether.

Helium Producer in Arizona

Kipling Petroleum Co., drilling for oil about 40 mi. east of Holbrook, Ariz., has encountered natural gas containing an unusually high percentage of helium. Information from the Arizona state land department is that the gas from sands at 775 ft. showed a helium content of 7.3 percent. The same source reported that early last month drilling had reached slightly over 1,000 ft., at which time no analysis of the bottom-hole gas was available.

Thus far there has been no commercial production of helium in Arizona. Large-scale recovery of the gas has been centered in Texas and New Mexico, where the output has been managed and controlled by the federal government. At present there is no prospect, according to sources in the Arizona land department, of an immediate demand for the helium that the well at Holbrook could supply. Last month, Kipling Petroleum planned to continue drilling for oil. Arizona has no significant output of petroleum thus far.

Masonite Builds Second U. S. Plant

Masonite Corp. expects soon to put into operation at Ukiah, Calif., the second wood fiber hardboard plant in the United States. This is the most modern and most highly mechanized such plant owned by the company, which began construction of the first Masonite plant at Laurel, Miss., in 1926. The firm has one plant each in five foreign countries. Capacity at Ukiah is between 400 and 500 units per day of logs.

Ukiah was selected as a plant site because of an adequate supply of Douglas fir and redwood in the vicinity and because of the availability of highway and rail transportation. The company owns a 55,000-acre tract of timber in Mendicino county, where the plant is situated.

Logs up to 40 ft. long and 60 in. diameter will be hauled to the plant by truck, debarked by a hydraulic debarker and chipped. The chips are fed into cylindrical pressure "guns" 6 ft. long and having internal diameters of 20 in. Steam at 1,200 psi. is then valved into the chambers, where a temperature of 600 deg. F. is developed. After a residence time of less than a minute, pressure is suddenly released, causing an explosive disintegration of the steam-impregnated wood into fibers. The mixture of fibers and steam is then discharged at a velocity of about

2,000 mph. into a cyclone separator. The fiber stock is flowed on a board machine and matted. The cut, felted sheets are then transferred to hydraulic presses, where under a pressure of 2,500 psi., the fiber and lignin are converted to hardboard. No binding material is necessary.

Mill effluent (fine fibers and mud) is collected in a classifier, caked on a vacuum filter, flash dried and burned. Soluble matter in wash water from the fiber is concentrated in four single-effect evaporators to about 50 percent solids content, after which the material is burned under boilers which supply heat to the evaporators. Some research on the reclamation of the soluble matter is under way at Laurel.

The Ukiah plant was designed by the company's engineering department under the direction of F. G. Lesniak, who also headed the designing of the plants at Laurel and those abroad.

Plant officials at Ukiah include E. T. F. Wohlenberg, general manager, and Mr. Lesniak, chief engineer. Research and development work will be conducted at Laurel.

Dr. Knowles inspects a plot.

Safflower Gets Play in California

As a result of a marked increase this year in California acreage planted to safflower, an oilseed crop long grown abroad, a new oilseed crop for California should be harvested this month and during August. This is the first year that the oil will be available in commercial quantities from the state. The California acreage is around 25,000, of which 16,000-20,000 lies in the San Joaquin valley, 4,000 in the Imperial valley, the remainder being in the Sacramento valley. One company estimated in March that there would probably be available about 150 tank cars of the oil, but last month reported that the crop has been damaged somewhat by heavy winds and root rot.

Several seed crushers are interested in safflower as a source of drying oil and high-protein meal. The largest acreage is understood to be under contract to Oil Seed Products Co., Fresno. Pacific Vegetable Oil Corp., San Francisco, is also considerably interested. Other California firms with acreages are Glidden Co., Buena Park, and S. A. Camp Cotton Oil Co., Shafter.

One of these firms declares that "Safflower is more similar to linseed oil than soya in most of its characteristics. The raw oil will air-dry with or without driers comparably with linseed. However, the dried film is somewhat similar to a soya oil film in that it is softer and has similar non-yellowing properties upon aging. These properties follow through also in alkyds made with safflower compared with equivalent oil length linseed products, with possible exception of very low oil length resins. Cooking schedules in manufacture of most alkyds and oleoresinous products follow the linseed oil procedure more than soya. At the present time a great deal of investigation is being conducted by private concerns interested in the use of safflower as a replacement for linseed and soya oil in their protective coatings, but there is not a great deal of published information in regard to its use in conjunction with other oils or in special products."

Safflower development in California has followd several years of investigation by the University of California agricultural experiment station at Davis, Calif., under P. F. Knowles, who has had the collaboration of University of Nebraska specialists in developing a high-yield variety for the central valleys.

The seed is expected to range between 25 and 37 percent oil content depending on locality and seasonal conditions. Several authorities believe that as a general purpose oil the product will be priced somewhere between linseed and soya oils.

New Gas Supplier Seeks Utah Market

A new company, Utah Natural Gas Co., aiming to provide the Salt Lake valley with large supplies of natural gas for industrial and commercial purposes, has applied to the Utah Public Service Commission for a certificate of public convenience and necessity. The company seeks to construct a 325-mi., $25-million pipeline from the Four Corners field in southeastern Utah. Since the line would lie wholly with the state, approval of the Federal Power Commission would not be needed.

The Salt Lake City region is already served by Mountain Fuel Supply Co. chiefly from wells in the Church Buttes field of Wyoming. However, despite the drilling of new wells in the field, consumers of natural gas in the area have been feeling the pinch of a tight supply. Utah Natural Gas Co. maintains in its application that present industrial and commercial supplies of gas are inadequate to meet the demand, and that the proposed new pipeline will not be competitive with established distribution systems.

Steel fabrication industries attracted by the Geneva Steel Co. plant at Provo, and smelting and refining firms in the Salt Lake valley, as well as copper fabrication firms that might likewise be attracted to the region, are believed to be potential new users for gas from the Four Corners field if the new 22-in. pipeline project is authorized.

John A. McGuire, of Lowell, Mass., president of the company, says that substantial production and reserves have been established in the San Juan county (Utah) section of the field. A combination of interests has large holdings in the field, including Byrd-Frost Co. of Texas, Paul English of Farmington, N. M., and McGuire, Morgan & Walton of Salt Lake City, and others.

Coast Oil Firm Enlarging Sesame Capacity

Pacific Vegetable Oil Corp., San Francisco manufacturer, exporter and importer of vegetable and marine oils, believes there is a good prospect that sesame will develop as a profitable oilseed crop for regions in the West. The company, which is the largest importer of sesame seed and oil in the country, has been processing sesame since 1930, and is enlarging its capacity by bringing a sesame oil purification plant from Mexico City. The purpose of the plant is to obtain a byproduct, sesamin, which is used in the insecticide industry, as well

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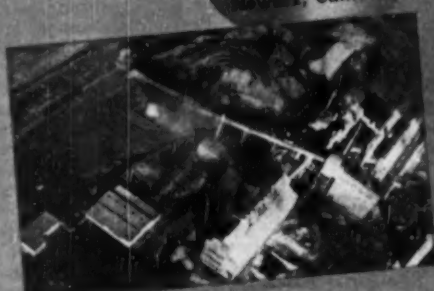

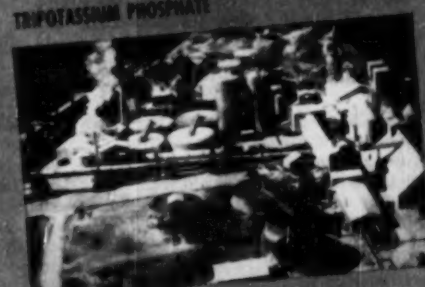

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as purify the oil by removing the color bodies and free fatty acids.

The Mexico City plant, designed and built by E. A. Hill, production manager for Pacific Vegetable Corp., was operated by Aceitera Carmen Co. Pacific Vegetable Oil is having it dismantled and expects to have it in operation at Richmond, Calif., in the latter part of July. The combined capacity of the unit already at San Francisco and the one being brought from Mexico will be more than double the capacity of the present unit. The company has been obtaining most of its sesame seed from Central America and China.

Company officials point out that the shattering characteristics of sesame in the field has been a serious obstacle to mechanized harvesting and therefore to profitable domestic cultivation. They think there is a prospect that in the next few years a non-shattering variety will be developed through experimental work now under way. The seed has marked advantages by reason of its high oil content (higher than cottonseed, soy and peanuts) which is exceptionally stable and of light color.

The Basic Magnesium area at Henderson, Nev. Stauffer occupies the property outlined in black.

Stauffer Invites Company at Basic

Stauffer Chemical Co., one of the energetic and growing chemical firms of the West, has conceived an ingenious and unusual idea for getting more business and at the same time minimizing freight charges on Stauffer chemicals made at Henderson, Nev. For five years the company has operated a portion of the huge Basic Magnesium Project, a property administered by the Colorado River Commission for Nevada, and manufactures caustic soda, chlorine, hydrogen, benzene hexachloride, and muriatic acid.

Despite recent newcomers to Henderson there is still plenty of land and equipment available. Accordingly the company hit upon the logical idea of inviting more companies to Henderson who would consume Stauffer chemicals on the spot, and has issued a brochure to chemical consumers and construction firms outlining what Henderson has to offer. Subject matter: chemicals being made there by Stauffer and others, utilities, transportation, labor supply, housing, land and equipment available, and construction companies in the vicinity.

Tussle Develops Over Trans-Northwest

A tussle over how and by whom Canadian natural gas (when that product finally enters the Pacific Northwest) will be distributed to fuel-hungry industries in Washington was developing last month in the state. This occurred as the result of changed and more ambitious plans of the new Washington firm, Trans-Northwest Gas Co., Inc., that seeks to distribute Canadian gas to local gas companies.

Originally the firm planned only to construct laterals (*PPI*, June) to such companies from a trunk line in Washington that would be owned and operated by the successful corporation among several contenders currently hoping to obtain authority to export gas from Alberta to the Pacific Northwest. Now, however, Trans-Northwest seeks to obtain what is being interpreted as an exclusive franchise to build both the trunk line and distribution laterals. A hearing before the state highway department on the company's application for a franchise to build both trunk and laterals along highways has been set tentatively for this fall.

Seattle Gas Co. is expected to intervene at the hearing. Gas companies in Washington had not been looking for the emergence of Trans-Northwest between themselves and the Canadian exporter of natural gas.

In an interview at Spokane a few weeks ago, Paul H. Graves, president of Trans-Northwest Gas, assumed the position that an exclusive franchise in what would probably be the major portion of the market outlet for Canadian gas would give his company a strong position in any negotiations with the successful Canadian supplier as to route, capacity and price of the delivered gas, thereby assuring reasonable prices to gas companies in Washington.

Canada Has Own Gas Contest

While the aspirations of Trans-Northwest Gas, Inc. to control the distribution of Canadian gas in Washington are creating a stir in that state, the contest in Canada is considerably wider. One angle involves the companies that are striving to win from Parliament and the Petroleum and Natural Gas Conservation board in Alberta, the province where the Canadian gas reserves are centered, the right to build the pipeline from the reserves southwest to British Columbia and the United States.

Among the major contenders (American capital is predominant in each) is Westcoast Transmission Co., Ltd., which has had extensive hearings before the Conservation board. This company plans a trunk line that would run down into British Columbia to Vancouver, with a southern branch extending from near Vancouver down through Washington. Northwest Natural Gas Co. seeks authority to run a line running from Alberta southwest through Idaho and Washington before swinging back up into British Columbia. Prairie Transmission lines would build a line substantially along the route favored by Northwest Natural Gas Co. Hearings before the board in Alberta are expected to extend into this fall.

On the political front, the Canadian government takes the position that no gas can be exported from the country until it is definitely determined that the terms of any export authority will fully protect probable long-term domestic requirements. This is the same position assumed by the Alberta government, whose people, accustomed to using gas at low prices and hopeful that such gas will attract future industries, are pessimistic about the effect on price and reserves of a pipeline carrying large quantities into the United States.

British Columbia, seeking gas for its own industrial growth at Vancouver and in the interior, has its representatives in the Canadian government supporting a pipeline route that would first pass through the province to Vancouver before any gas is taken into the United States. This route appeals to British Columbia as one which would assure adequate gas supplies to the province regardless of the future volume of demand for gas from the American end. The argument heavily favors the so-called all-Canadian route proposed by Westcoast Transmission Co.

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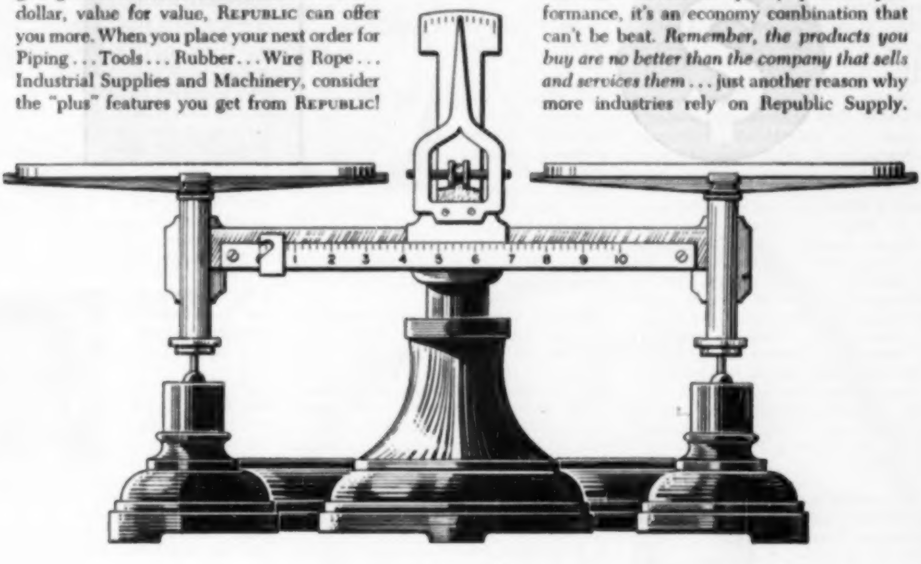

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NAMES IN THE WEST

E. Schuler

L. W. Eilertsen

Edward Schuler has been appointed general sales manager for the Western Division of Monsanto Chemical Co. He will remain in San Francisco, where he has previously been general sales manager for chemicals and plastics. A native of St. Louis, Schuler joined the company in 1926. Prior to becoming general branch manager of the San Francisco office in 1937 he had been assistant manager of the company's office in New York City. **Leo Eilertsen**, previously general sales manager of adhesives and special products, has become assistant to the general manager of the Western Division. He joined I. F. Laucks, Inc., predecessor of the division, in 1919, and became vice president in 1944 when Monsanto bought the firm. He was elected president of the Association of Washington Industries this year.

Donald J. Miller has been appointed manager of Monsanto Chemical Co.'s new polystyrene molding compound plant at Long Beach, Calif. A native of Texas, and chemical engineering graduate of Washington University in 1941, he joined the company in that year at the Springfield, Mass., plant. Until the change he was laboratory supervisor at Springfield. At the same time, **Joseph R. McCleskey, Jr.**, has become plant supervisor at Long Beach. He was previously a supervisor at Springfield, and is a chemical engineering graduate of Alabama Polytechnic Institute (1942).

K. H. Crandall

K. H. Crandall has been elected a vice president of Standard Oil Co. of California. Since 1947 he has been vice chairman of the board of the California Co., a Standard subsidiary operating in the Rocky Mountains and the Central and Gulf Coast regions. He has been director of another subsidiary, Standard Oil Co. of Texas, since 1948. He joined the California Co. in 1925, and became a director and vice president in 1942, then president in 1945. He is a graduate of Stanford University.

Richard F. Hoagland has become vice president and assistant general manager of Utah Fuel Co., subsidiary of Kaiser Steel Corp. Prior to his appointment he was manager of byproduct sales for Kaiser with headquarters in Los Angeles. He has been transferred to headquarters of Utah Fuel Co. in Salt Lake City.

F. A. Cutter

Fred Cutter, vice president of Cutter Laboratories, Berkeley, Calif., has become president of United Employers, Inc., an organization representing over 1,000 firms in Alameda and Contra Costa counties in management-labor relations. For several years he has served as vice president and member of the board of the organization. Cutter's firm is a manufacturer of penicillin and other biologicals at Berkeley.

C. H. Snell

C. Harry Snell has become district manager of Celanese Corp. for the western sales area, with offices in San Francisco. He is in charge of sales of industrial organic chemicals that the company manufactures at Bishop, Tex. Snell was previously western representative for the company. He is a graduate chemist from Hope College in Michigan.

Charles A. Priode has become administrative assistant to Charles N. Gross, manager of the manufacturing divisions at Hanford Works, Richland, Wash. Priode came to Hanford this year as staff assistant of the divisions. Previously he was assistant superintendent of Polythene production at the Sabine River works (Orange, Tex.) of the Du Pont organization. He was with Du Pont 12 years. A native of West Virginia, he holds a science degree from Ohio University.

J. B. Sutherland has been temporarily relieved of his duties as Los Angeles division manager of Ohio Oil Co. because of illness. **R. M. Miller,** division superintendent, is handling Sutherland's work for the time being.

A. MacGillvray

Alexander MacGillvray has been elected a vice president of Gladding, McBean & Co., large manufacturer of diversified ceramic products. MacGillvray, who joined the company in 1949, will direct the administration of accounting and financial matters, budgets and market research, with headquarters at Los Angeles.

G. Schumacher

Gordon Schumacher, former assistant district manager in Los Angeles for Hagen Corp. and its affiliates, Calgon, Inc., Hall Laboratories, Inc., and Buromin Co., has been made manager. He succeeds **R. L. Sullivan,** who has resigned to form his own firm. Schumacher joined Hagen in 1942. Prior to that he was employed by Consolidated Western Steel Corp. He is a chemical and petroleum engineer. Assisting him is **Joseph R. Shafer,** who joined the firm in 1941 in an engineering capacity.

D. F. Shaw

David F. Shaw has been made manager of Hanford Operations at Richland, Wash., succeeding **Fred C. Schlemmer,** who resigned to enter private industry. Shaw has been assistant manager and deputy manager for the last three years. He is an engineering graduate of Georgia School of Technology. After graduation in 1934 he worked with Tennessee Valley Authority in building three major dams. After World War 2 service he was assigned to the Manhattan Engineering District for atomic bomb work. He came to Richland in 1947.

J. D. Fredericks

John D. Fredericks has been elected president of Pacific Clay Products Co. at Los Angeles, replacing the late **Roy Lacy.** Fredericks has been with the company for 25 years in the capacities of attorney, assistant secretary, general counsel and, more recently, vice president. He is the son of the late **John D. Fredericks, Sr.,** who was a former president of the firm, manufacturer of ceramic pipe, glazed floor and wall tile and architectural terra cotta products in plants at the California localities of Los Angeles, Los Nietos, Stockton and Alameda.

Milton R. Beychok has become chemist for Rothschild Oil Co., which operates a petroleum refinery at Santa Fe Springs, Calif.

E. L. Foreman has been appointed director of research for S. M. Pharmaceuticals Division of Special Milk Products, Inc., at Los Angeles, where he has assumed charge of laboratories and development of new products.

M. W. Kibre, assistant manager of General Petroleum Corp.'s gas department

since 1945, has become manager, replacing **H. L. Eggleston**, resigned.

J. O. Julson has succeeded **Marvin C. Jones** as manager of the Weyerhaeuser Timber Co. container board plant at Springfield, Ore.

Rodolfo Hernandez Corzo has been selected as the first international research fellow of Stanford Research Institute, Stanford, Calif. His appointment for a two-year term at Stanford was made by Carlos Novoa, director general of Bank of Mexico. The appointee holds degrees in chemistry and bacteriology from the National School of Biological Sciences in Mexico, which he has directed since 1945, and which post he retains. He obtained a master of science degree from Northwestern University in 1940.

R. H. Corzo

Vance N. Jenkins, research supervisor of Union Oil Co. of California, was elected president of National Association of Corrosion Engineers at the annual meeting this year.

D. W. Pearce has become assistant to A. B. Greninger, manager of technical divisions at Hanford Works, Richland, Wash. Among his duties will be liaison with the technical activities of other atomic energy sites. It was announced last month that **F. W. Albaugh** would be transferred to the technical services division as assistant division head, and will be in charge of the analytical section, which Dr. Pearce formerly headed. **F. J. Leitz** was scheduled to become assistant chief of the chemical research section.

E. T. F. Wohlenberg, general manager of the new Masonite Corp. hardboard plant at Ukiah, Calif., has been elected chairman of the California Redwood Council, an organization that has been formed by members of forest industries in the redwood region.

R. C. Clark, manager of the refinery of Utah Oil Refining Co. at Salt Lake City, has become a director of the company. Clark, an engineering graduate of Cornell, replaces **M. J. Greenwood**, who asked to retire from the board.

FIRMS IN THE WEST

Bechtel Corp., San Francisco, has announced that Arabian Bechtel Co. has obtained a contract from Iraq Petroleum Co. for construction of a 556-mi. pipeline running from the Kirkuk oil field in Iraq to the Syrian coast of the Mediterranean. Capacity will be about 300,000 bbl. per day.

Douglas Fir Plywood Association has elected Frost Snyder, president of Vancouver Plywood Co., president. Other association officials named are Victor Olson, president of Washington Veneer Co., vice president; Charles M. Ducey, treasurer and general manager of Menasha Plywood Corp., secretary.

Standard Oil Co. of California will distribute 16 graduate fellowships, with a total value of $23,000, among 11 universities for the academic year 1950-1951. The schools and the fellowships involved are: University of California, mechanical engineering and paleontology; University of California at Los Angeles, chemistry and mechanical engineering; Stanford University, mechanical engineering and geology; California Institute of Technology, chemical engineering, physics and geology; Oregon State College, mechanical engineering; University of Washington, chemical engineering; University of Chicago, physics; University of Illinois, chemistry; University of Wisconsin, chemical engineering; University of Michigan, chemical engineering; Harvard University, chemistry.

Richfield Oil Corp. has completed in the Cuyama valley oil field in California a second natural gasoline recovery plant with a gas processing capacity of 30 million ft. per day. Natural gasoline, propane and

butane are the products recovered. The company put a plant of similar capacity into operation last fall.

S. Paul Ward, Inc., manufacturer of ceramic glazes and distributor of ceramic supplies at Los Angeles, is erecting a new building to enlarge storage space and shipping facilities.

National Cylinder Gas Co. has arranged with Iceco Corp., manufacturer of dry ice in northeastern New Mexico, to distribute a portion of Iceco's product along the California coast, Texas and adjoining localities. The dry ice is produced from carbon dioxide wells in New Mexico with a daily productive capacity of up to 100 tons.

Union Oil Co. has acquired United Geophysical Co., which is headed by Herbert Hoover, Jr., and has announced that no changes will be made in the management of the latter firm, which will continue to maintain its offices at Los Angeles.

The Stuart Co. plans construction of a research laboratory for pharmaceuticals at Los Angeles. The building to be erected will house the laboratory and the Chicago firm's Western Division offices. Investment involved is about $400,000.

Imperial Oil Co., Ltd., has completed a new casinghead gasoline plant at Leduc, Alta., with an initial capacity to process 17 million ft. of gas per day and a planned ultimate capacity of 24 million ft. The plant was built to recover gasoline components from oil wells in the Leduc-Woodbend field.

Natural Gas Equipment Co. has acquired representation in California, Oregon, Washington and Arizona for products of Valve and Primer Corp. of Chicago and has obtained a new office building and warehouse at Pasadena, Calif. The firm is also western representative for Surface Combustion Corp. and other manufacturers of fuel equipment.

United States Gasket Co., Camden, N. J., has appointed W. S. Shamban & Co., Los Angeles, exclusive representative for California.

Cal Dri Ice Co. is producing dry ice from a new carbon dioxide well at the company's plant near Hopland, Calif. Production from the new 790-ft. well has increased capacity of the plant to 21,600 lb. of dry ice per day.

Shell Development Co. has made extensive organization shifts in research and development activities at Emeryville, Calif. Named associate directors of development are B. M. Beins, mechanical engineering; M. Souders, Jr., chemical engineering; C. L. Raymond, process engineering; and D. L. Yabroff, process development. Other appointments include C. R. Nelson as head of process engineering; G. E. Lindholm and A. J. Cherniavsky assistant heads; G. A. Nelson as staff metallurgist; W. E. Hand as head of costing and appraisals; P. D. Hishon as chief draftsman in development; and P. R. Hoyt and M. V. Long as staff consultants on instrumentation. D. J. Pompeo is head of a new department that centralizes the instrument research and development groups. T. W. Evans is director of the research division. A. J. Johnson, vice president and director of development, is in charge of the development division. H. E. Randlett, Jr., became administrative assistant to the director of research.

Matthews & Dennin is a new partnership established in San Francisco in the Matson Bldg. to distribute paint ingredients and industrial chemicals. Ransdell Matthews and John W. Dennin were previously partners in S. L. Abbot Co. at San Francisco before they relinquished their interests. They will cover territory between Bakersfield, Calif., and Oregon.

JULY 1950

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Chemical Engineering

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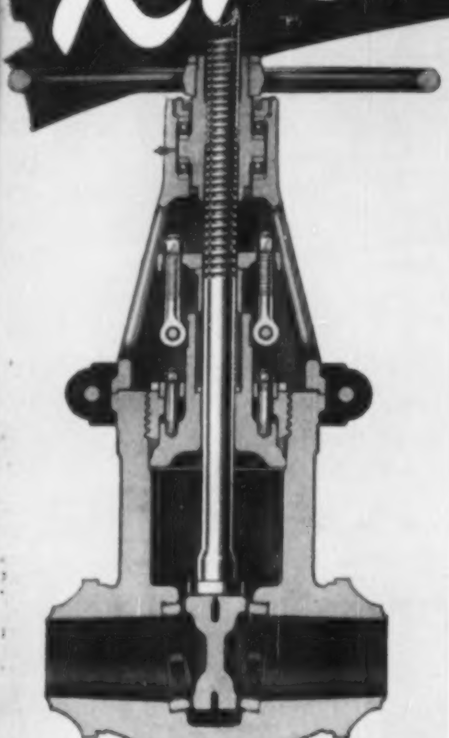

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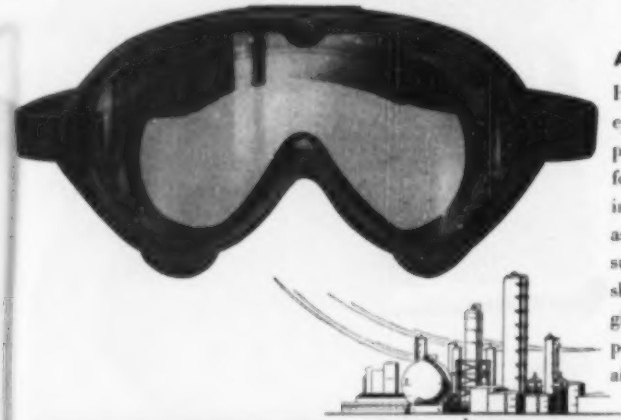

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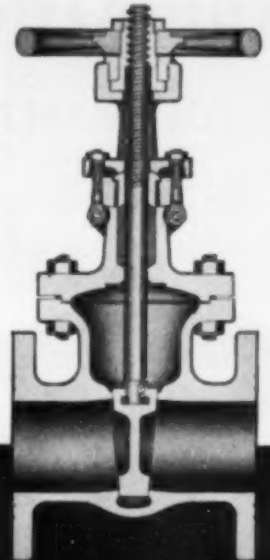

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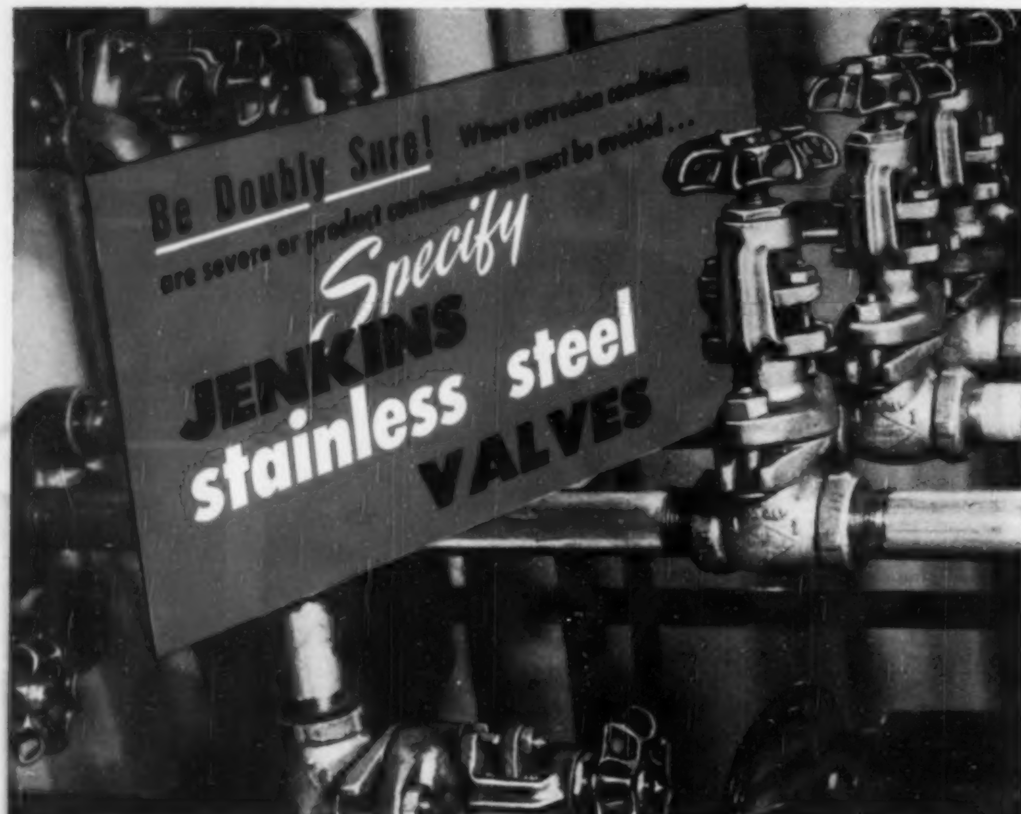

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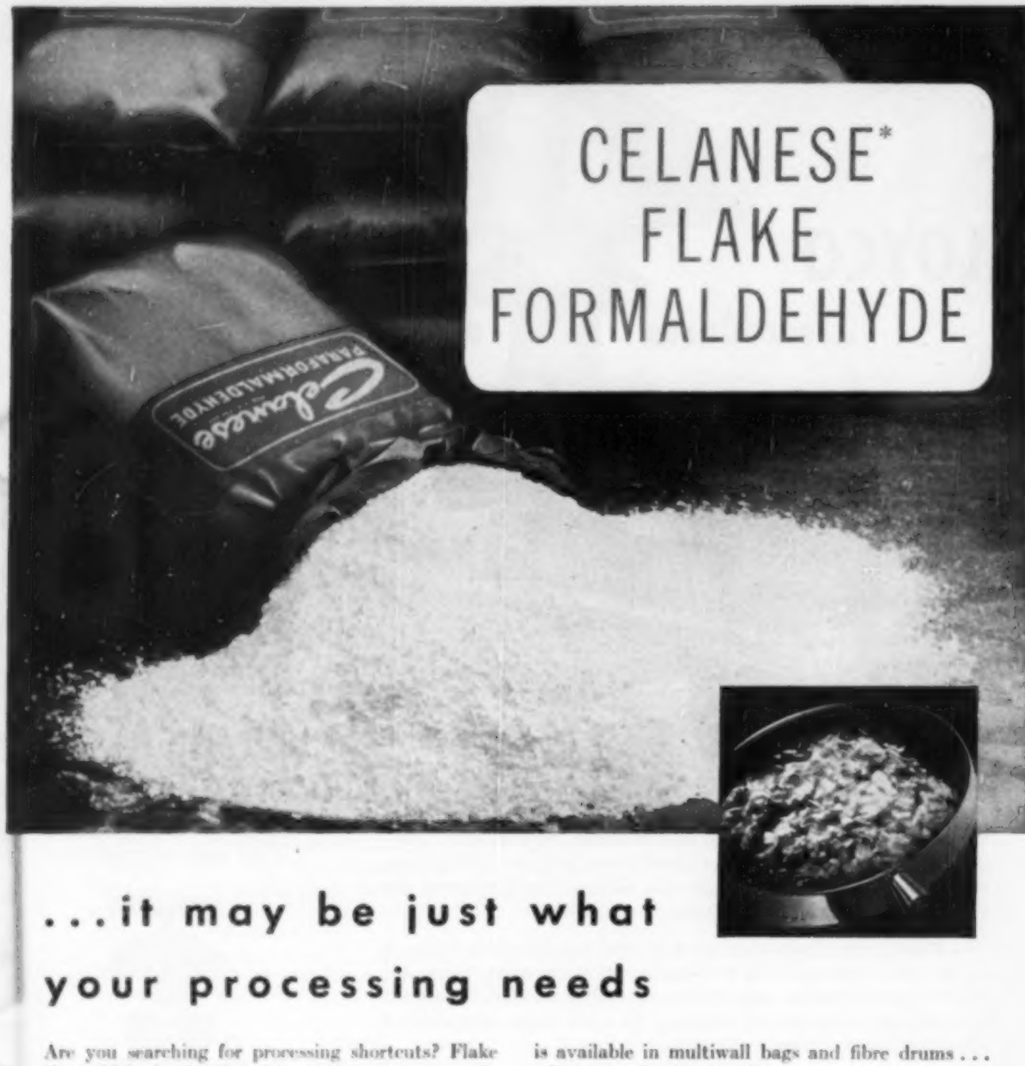

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We'd like to talk to you about your particular problems . . . tell you about other advantages that flake has to offer. Call your Celanese representative, or write: Celanese Corporation of America, Chemical Division, Dept. 53-G, 180 Madison Ave., New York 16.

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CHEMICALS

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ACIDS · ALCOHOLS · ALDEHYDES · GLYCOLS · KETONES · PLASTICIZERS · SOLVENTS

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with CROUSE-HINDS

. . . . . bells, horns, sirens, and visual signals

Raintight signals for non-hazardous locations

The most complete line

Type WH Raintight Horn with Single Projector

Type WH Raintight Horn with Double Projector

Type FS Raintight Pilot Light Condulet

Continuous production is of vital importance in successful plant operation. Costly shutdowns can often be avoided by Crouse-Hinds signals that give an instant warning of abnormal operating conditions or sound an alarm in case of fire.

A wide variety of signals is necessary to meet the varied conditions in industry. Crouse-Hinds offers a comprehensive line of signaling devices for plant protection and communication . . . . . sirens, horn, bells, and visual signals. Each unit is designed with individual characteristics that make it superior for a particular kind of service. There are Crouse-Hinds signals for use in non-hazardous locations; raintight signals for use where exposed to the weather; explosion-proof and dust-tight signals for use in hazardous locations; signals with a low volume of sound and high power signals that are extremely loud.

You have a definite advantage in selecting signals from the all-inclusive Crouse-Hinds line. It is possible for you to meet the requirements of every location. In noisy areas the character of the noise is of first importance. A signal producing a sound having the greatest contrast to the area noise should always be selected. For example, a horn would not be suitable in

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Signaling Devices

for control of operations, and fire protection.

of explosion-proof and dust-tight signals for hazardous locations

surroundings where a constant hum or whine is present but a bell could readily be heard. A bell would be inadequate in surroundings where the noise is produced by hammering on metal but a horn would give the required contrast.

Careful consideration should also be given to the number of signals required. In general, much better coverage is obtained by even distribution of several low output units than by one or two high output units. On the other hand, a high powered unit is necessary when the sound must be projected a considerable distance from one location.

Crouse-Hinds' line of visual signals includes a variety of pilot lights and also the Visularm, a compact unit used to supervise manufacturing processes. The Visularm will automatically indicate normal and abnormal temperature, liquid level, speed, load, or any other condition which can be electrically coupled to the circuit. An independent circuit is provided in the Visularm to actuate an audible signal.

In Crouse-Hinds' complete line there are dozens of different units from which to choose the items to meet your particular requirements. They are all listed in the Crouse-Hinds Condulet Catalog.

Type ETH Explosion-Proof Siren

LESS THAN 25 POUNDS IN WEIGHT

THE ***NEW*** PHILADELPHIA TYPE SM-OO
LIMITORQUE
VALVE CONTROL

FOR SMALLER VALVES

This new Philadelphia development fills a long felt need—a low cost control unit for the remote operation of smaller valves—4 inches or less—under 500 p.s.i. pressures and temperatures up to 800°F.

The Type SM-OO is really a "little giant"—while it is extremely compact and weighs under 25 pounds, its specially designed high speed, high starting torque motor will develop a thrust of 500#.

All the widely used standard LimiTorque features have been incorporated into the design of the Type SM-OO (see below) . . . it is not in any way "built-down" to meet a price.

These units are normally supplied with motors operating on single phase, 110 Volt house current or 110 Volt D-c.

A special compact control enclosure has been developed especially for use with the Type SM-OO.

CHECK THESE FEATURES

1. *Micrometer torque seating switch.*
2. *Self contained unit—no gears, nut or bearings to buy.*
3. *Weatherproof, dust-tight and watertight.*
4. *Hammerblow device, which permits motor to attain full speed before encountering load.*
5. *Non-rotating handwheel built into unit for rapid manual opening or closing of valve.*
6. *Automatic declutch mechanism disengages handwheel when unit is under motor operation.*
7. *High torque motors.*
8. *Simple valve yoke.*

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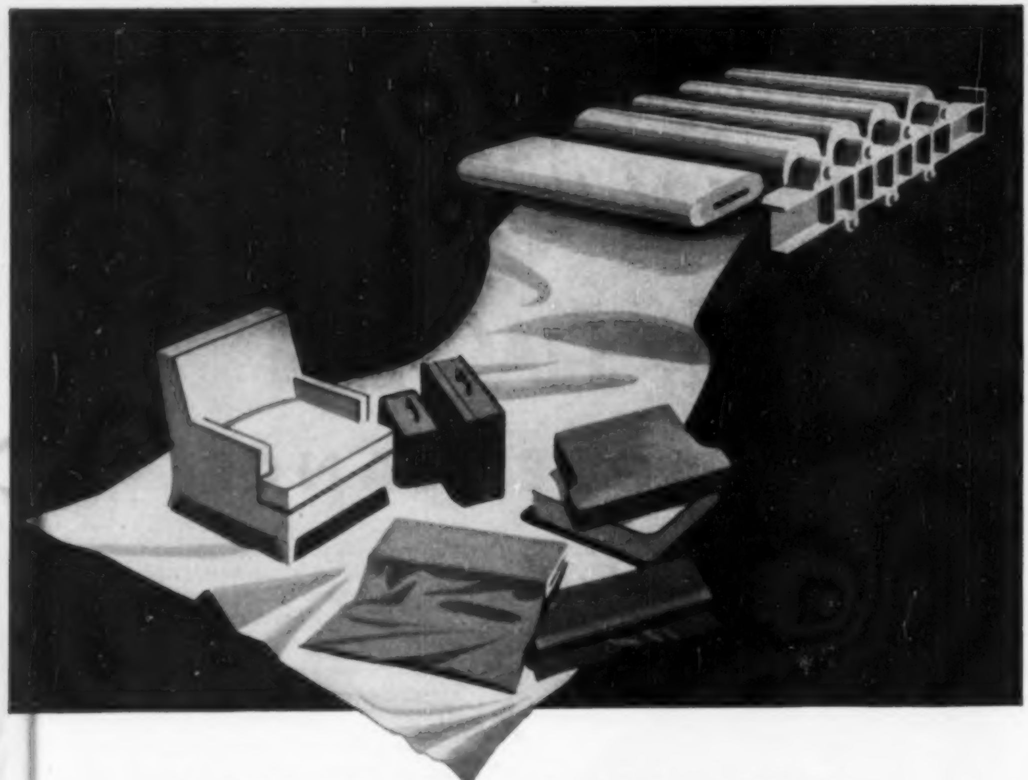
Industrial Gears and Speed Reducers
LimiTorque Valve Controls



Rolling Fabric Into Extra Profit

Take an attractive but inexpensive fabric or paper. Laminate to it a thin vinyl film. Then watch it sell like hot cakes . . . and at a premium. Essentially, that's the story behind one of America's fastest growing new product developments . . . one with wide potentialities still to be explored. Before commercial success could be achieved, machinery had to be devised for low-cost lamination and to provide fast switchover from one paper or fabric to another. Lukenweld developed 2 units, with driven jacketed stainless steel heating and cooling rolls mounted in an inexpensive welded plate frame. Today, similar machines are in wide use throughout the industry.

Maximum product dependability with minimum cost are the result of years of experience of Lukenweld engineers working with steel plate. Higher predictability, improved appearance, resistance to shock, reduced weight, increased strength and rigidity, more flexibility of machine design, reduced production costs and elimination of patterns usually result from the use of Lukenweld construction. Here at your disposal are Lukenweld's knowledge of machine design, construction, installation . . . plus Lukens 140 years' experience in developing and producing specialty steels.

If you are considering new cylinder drying machinery, processing machines or other finished units, write Lukenweld, Division of Lukens Steel Company, 400 Lukens Building, Coatesville, Pennsylvania.

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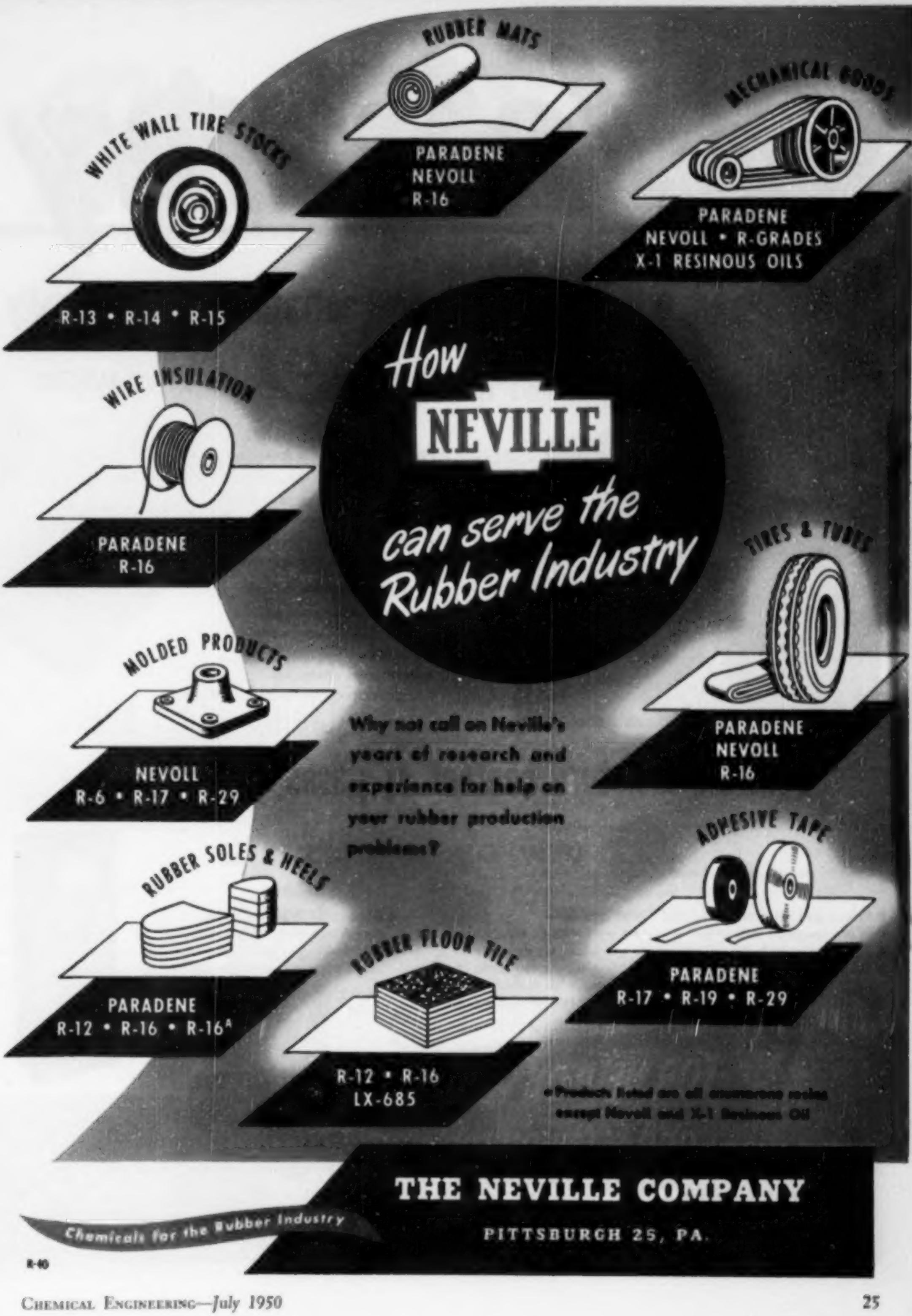

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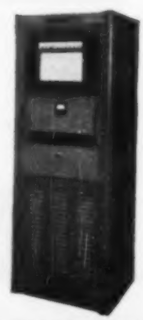
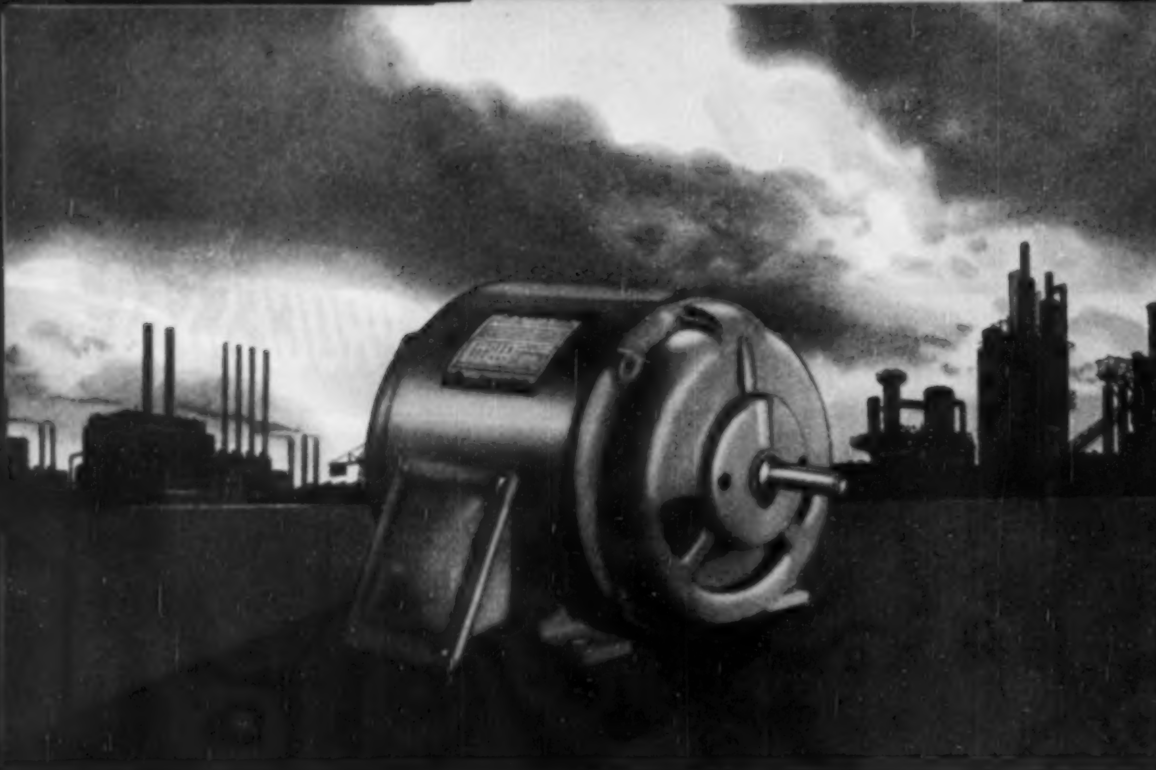
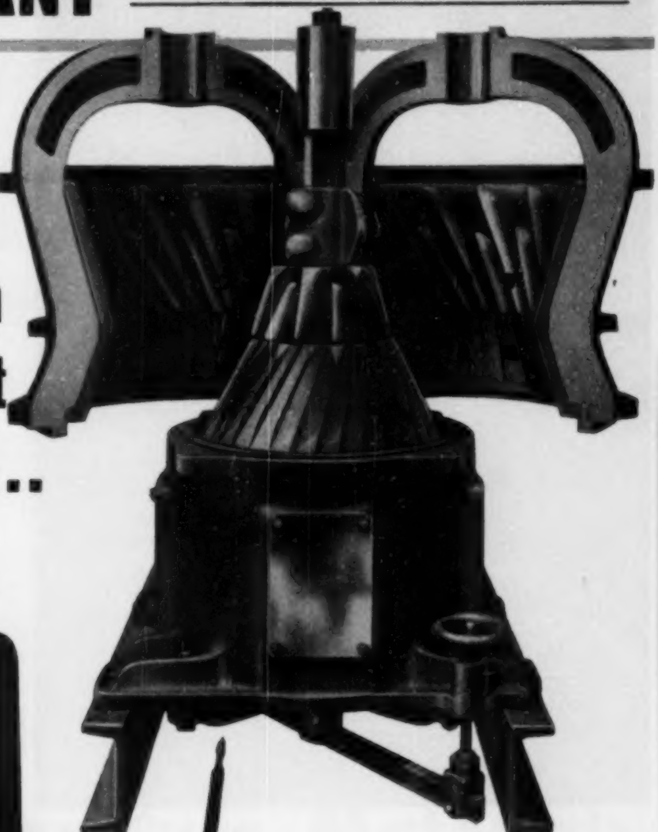
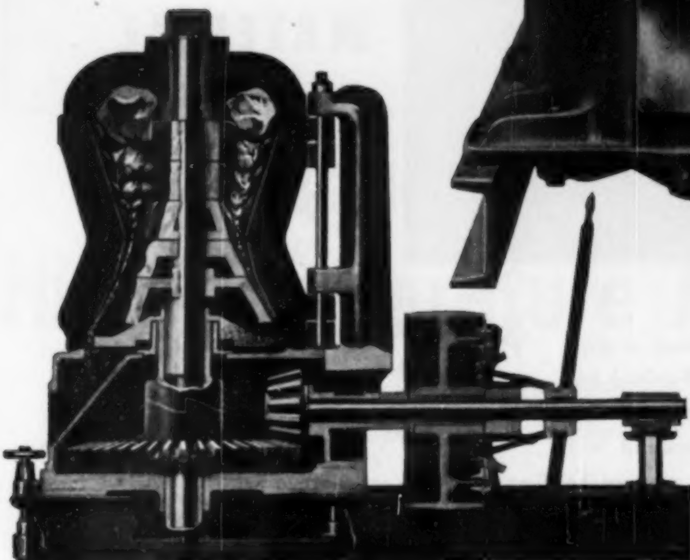


FOR HELP ON your measuring and testing problems . . . call the nearest G-E sales office.







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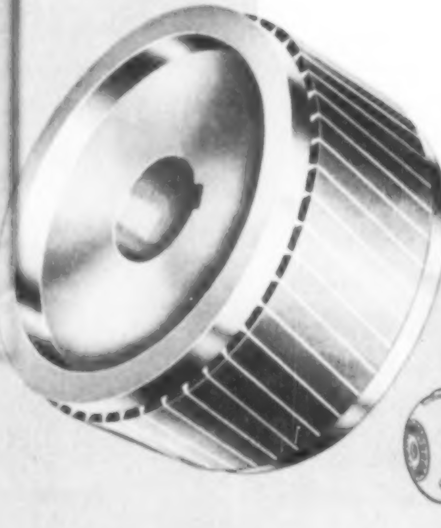
In your Fairbanks-Morse branch you have a single source for all your motor and generator requirements. There you can get advice and service that are not limited by restrictions in available sizes and types — that are underwritten by the broadest contact with motor applications like yours. Hundreds of plants are fully equipped with motors bearing the Fairbanks-Morse name — including everything from fractional ratings — through standard and specialized types of all sizes — up to and including large generating equipment. Why not have this experience working for you? Write or call the nearest sales center listed below.

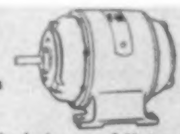
Axial Air-Gap Motors

EXCLUSIVE *Copperspun Rotor* IS INDESTRUCTIBLE . . .



Identifying all Fairbanks-Morse motors in the more popular ratings, the Copperspun Rotor is a prime reason for their reputation for long-run sturdiness with little maintenance expense. Truly indestructible, the rotor is centrifugally cast and, with its well proportioned shaft, dynamically balanced to insure smooth and quiet operation. This exclusive Fairbanks-Morse feature is another reason why you should visit or write your nearest Fairbanks-Morse sales center to get the whole story on the motors which interest you.

General-Purpose Protected Frame Squirrel-Cage Motors



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MORE ON NEXT PAGE

Bulletin on SUPER REFRACTORIES by CARBORUNDUM

TRADE MARK

NO. 8 JULY, 1950

Are Super Refractories Limited to High Temperature Applications?

High temperature resistance is an inherent characteristic of super refractories by CARBORUNDUM. However, there are other properties which may be equally important reasons for selecting such refractories — for low as well as high temperature work.

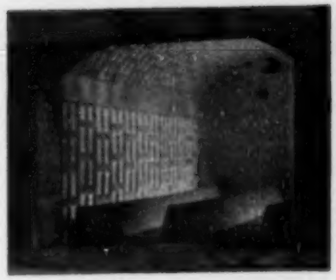
The heat flow rate of CARBOFRAX silicon carbide refractories, for example, is practically the same (for the same temperature difference) at low temperatures as it is at high. Likewise, such properties as chemical stability, hot strength, wear resistance, and heat shock resistance are equally effective in low temperature jobs. Consequently, refractoriness as such, often becomes a secondary reason for picking a super refractory, even where elevated temperatures are involved.

Lowered fuel costs, more production, and appreciably reduced maintenance expenses are all demonstrated benefits of these super refractories that have been realized for reasons aside from high temperature resistance. And although other refractories may be considered adequate from a life standpoint in many low temperature jobs, there is every probability that substantial savings can be effected by proper use of *super refractories* by CARBORUNDUM.

Physical Properties of Super Refractories by CARBORUNDUM

Trade Mark

	CARBOFRAX Silicon Carbide	MULLFRAX Electric Furnace Mullite	MULLFRAX S Converted Kyanite	ALFRAX K	ALFRAX B	ALFRAX BI
				Electrically Fused Alumina		
Heat Conductivity at 2000° F. in BTU/hr. sq. ft. and °F./in. of thickness	109 BTU	16 BTU	9 BTU	24 BTU	12 BTU	7 BTU
REFRACTORINESS PCE CONE	37-40	38-39	37-38	37-39	39-40	38-39
SPALLING RESISTANCE	High	High	High	Good	Good	Good
ABRASION RESISTANCE	High	Medium	Medium	High	Medium	Low
THERMAL EXPANSION (25° — 1400° C.)	.0000044	.0000059	.0000069	.0000074	.0000086	.0000086
MODULUS OF RUPTURE @ 2460° F. PSI	800-3125	100-250	175-475	100-1050	100-225	50-100
WEIGHT 9 IN. STRAIGHT	9.25 lbs.	9 lbs.	8 lbs.	10.1 lbs.	7.25 lbs.	4.8 lbs.



Muffle Performance Tells the Story

This photograph shows an ALFRAX electrically fused aluminum oxide muffle after six years in a porcelain enameling furnace. For four years, the furnace operated continuously on sheet steel and cast iron stove part production. Then, it was turned to stress-relieving work on heavy armor parts at a temperature of 1295° F. Loads of armor averaged 450 lbs. — were left in the furnace four hours. There were three loads a day, and during each change the temperature was dropped to 800° F. and then returned to its operating temperature.

After six years of this rigorous but relatively low temperature service, the only thing needed in this furnace was a new bottom! The low thermal expansion, chemical inertness and high cracking resistance of the ALFRAX tile kept the side walls and arch in first class condition — and without maintenance. Furthermore, high strength permitted use of thinner tile — aiding heat transfer through the muffle — and assisting fuel economy. Similar advantages are possible in other installations, involving either high or low temperatures.

Uniform Heat Flow Required Here

Used over a varnish fire, this dome provides a soft, even radiant heat. This results from the high thermal conductivity of the CARBOFRAX silicon carbide material. Its use facilitates the "cooking" operation — extends kettle life. Resisting repeated heating and cooling, the CARBOFRAX dome gives longer service and reduces repair bills.

Address all correspondence to: Dept. H-70, THE CARBORUNDUM COMPANY, Refractories Division, Perth Amboy, New Jersey

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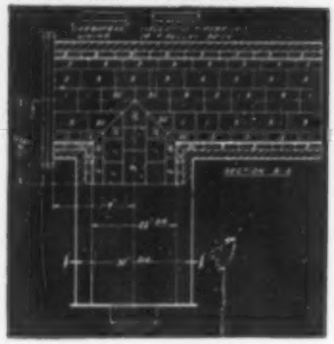
← Continued from other side

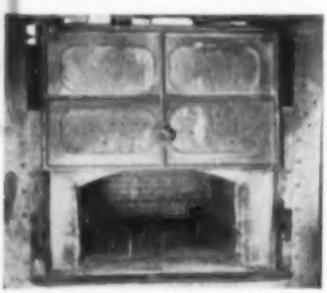


Hot Spots Eliminated in Flue Connector Linings

In the flue connecting a water-gas generator with its carburetor temperatures are relatively low. However, fireclay linings often erode in limited areas because of scurfing by the coke particles. Hot spots develop and production must be interrupted for repairs.

Since they are exceptionally resistant to erosion at both high and low temperatures, CARBOFRAX silicon carbide tile are ideally suited for this application. They retain their original thickness much longer, even at tees, ells and sweeps, where punishment is most severe. Also, the hard, dense CARBOFRAX tile resist carbon penetration and build-up. Elimination of expensive shut-downs, and of repeated repairs, quickly pays back the initial investment.

This is another example of where other specialized properties of CARBOFRAX brick and tile are more important than refractoriness.

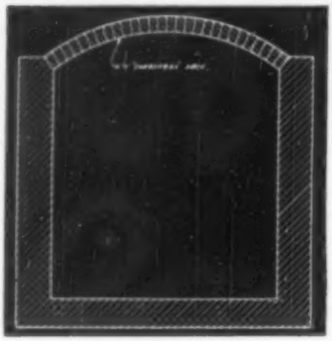


Abrasion, the Main Problem Here

Abrasion used to be the principal problem of this furnace. Operated at temperatures under 2000° F., the floor was worn away when aluminum-bronze castings weighing up to 700 lbs were dragged across it. The resultant unevenness of the hearth caused the castings to sag during heat treatment.

The problem has now been eliminated by using CARBOFRAX silicon carbide tile with their high abrasion resistance. The floor remains level, and distortion of castings avoided. Furthermore the hearth is still in operation after more than three years — a life figure that compares with about one a year for other types of hearths.

The high thermal conductivity of CARBOFRAX tile — another property equally useful at low temperatures — has also resulted in other improvements. First, more uniform and rapid heat delivery to the work chamber gives an improved heat treatment. Secondly, fuel consumption has been reduced. And, finally, the furnace can now be operated faster due to a quicker temperature come-back after being charged.



Super Refractory Picked for High Thermal Conductivity

This sulphur burner combustion chamber — shown in cross-section — is an interesting application of a CARBORUNDUM super refractory for a relatively low temperature job. The high thermal conductivity of CARBOFRAX silicon carbide brick is used to excellent advantage in the arch. Principally because of this feature it is possible to operate the unit at exceptional ratings and still maintain required temperatures of gases entering the Glover tower.

When a standard 9" thick fireclay arch is used in a burner of this type, approximately 1000 BTU's per hr. and sq. ft. are dissipated. A CARBOFRAX arch, however, dissipates approximately 4000 BTU's per hr. and sq. ft. This is due to the high thermal conductivity of the CARBOFRAX brick, and also because of the fact that their great mechanical strength makes possible an arch only 4½" thick. As a result, an extra ton of sulphur is burned each 24 hrs. per 24 sq. ft. of CARBOFRAX arch. Moreover, because of their low thermal expansion, inertness to furnace gases and absence of spalling and cracking, CARBOFRAX arches like this one are still in use after 18 years of continuous service.

Here Again, Refractoriness of Secondary Importance

In this gas-fired artware kiln, the high thermal conductivity of the CARBOFRAX silicon carbide muffle comes into play. It permits more rapid and uniform heat delivery to the ceramic ware — with a consequent improvement in ware quality and a decrease in the number of rejected pieces. Moreover, it is unnecessary to maintain as high a temperature in the combustion chamber to secure the requisite heat in the working chamber — which means longer life for the other refractories — and lower fuel costs.

Other characteristics of CARBOFRAX tile important here are: High strength, which permits using thinner tile to further aid heat transfer; and high resistance to spalling and cracking which means long life in spite of repeated heating and cooling.

20 Years of Continuous Service


ARRY F. NASH, PRESIDENT AND GENERAL MANAGER

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Youre very truly,

THE LEYDEN LIGNITE COMPANY,

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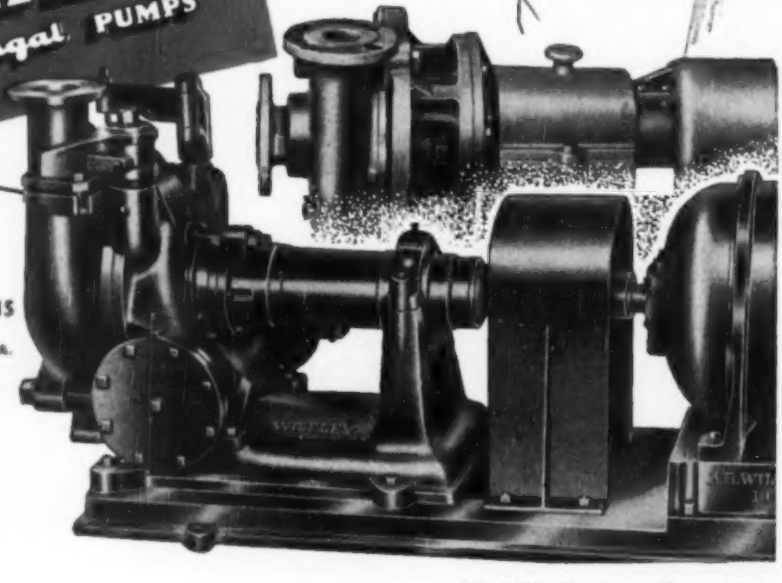

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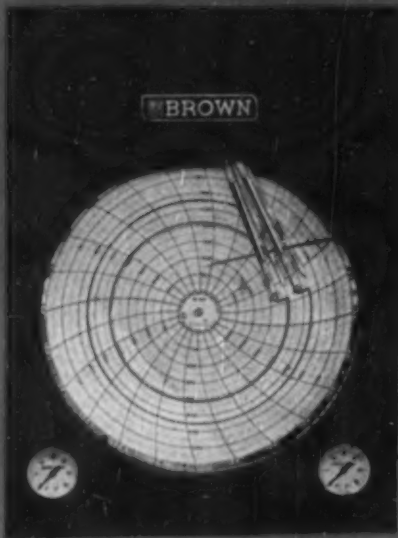

Recording Receiver

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Of Brown
ARE INDUSTRY

INSTALLATIONS in the petroleum and chemical industries now run into the thousands . . . each a testimonial to *plus values*, the outstanding features which have made Brown Pneumatic Remote Transmission of process variables the standard of comparison.

A list of the satisfied users of this system would look like a *Who's Who* of industry. And the number of repeat purchases is proof of continuous, long-term performance!

The Non-Bleed Pilot, The Matched Bellows, the high degree of Versatility and the unusual Accessibility have combined to set high standards of safety, convenience and economy in centralized instrumentation for years. Continuing research and engineering will keep Brown Pneumatic Remote Transmission in step with your needs.

Call in your local Honeywell engineer for a discussion of its application in your plant . . . he is as near as your phone! MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 cities of the United States, Canada and throughout the world.

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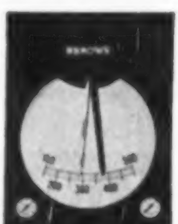

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Pneumatic Remote Transmission

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NON-BLEED PILOT

Special design and construction afford rapid and dependable response . . . keep air consumption low and maintenance at a minimum.

MATCHED BELLOWS

The Bellows and Springs of Transmitter and Receiver are "matched" in calibration . . . the key to the extreme accuracy of the system.

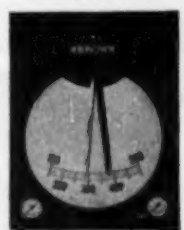
VERSATILITY

Indicating Transmitter can be located where you want it . . . with the Receiver recording up to three variables at a convenient, central point. Control can be from the Transmitter or Receiver.

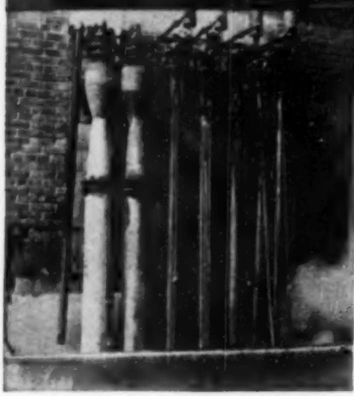
ACCESSIBILITY

Simplification of all units and components allows ample working room for installation as well as maintenance.

Indicating Transmitter



THIS *Scrub Team* BEAT THE FUME AND DUST MENACE



The four 48" SK Fume Scrubbers in the top view are used for absorption of sulphurous fumes in an oil refinery.

The two 6" SK Fume Scrubbers in the lower photo are made of Haveg and handle hydrochloric acid vapors at the plant of a large producer of synthetic materials.

OBNOXIOUS, contaminating fumes and vapors—heavy, corrosive and dangerous dusts—*need not* create a major plant problem, *can* be effectively and economically controlled.

To meet and master varying conditions in the battle against this menace, SK manufactures a wide range of types and sizes of Vapor Condensers or Fume Scrubbers—a team specially designed for such service.

If your conditions are such that fumes or dust can be knocked down and scrubbed with water or other liquid, an SK Fume Scrubber can do the job economically. Simple in construction, these units produce their own draft and give complete mixing without possibility of by-pass.

Standard and Special Fume Scrubbers are available in various materials such as cast iron, welded steel plate, Haveg, stoneware, hard lead and other corrosion resistant alloys or chemical resistant linings. Rubber lining is available with cast iron or welded steel plate.

For complete information, write for Bulletin 4-R. If your problem is immediate, call or teletype.

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you need U·S·S Stainless Steel

Here's a place where the inherent cleanliness of Stainless Steel is vital. This photographic glass washing machine was built of Stainless Steel by the Eastman Kodak Company, Kodak Park, Rochester, N. Y., for use in the Kodak Park Plant.

CHEMICAL processors have found an effective way to overcome one of their biggest problems—contamination. That's by maintaining absolute cleanliness in everything that touches their product.

Many have found, too, that there's one way to insure this necessary cleanliness. That's by making extensive use of the benefits of U·S·S Stainless Steel.

Stainless Steel's hard, smooth and durable surface won't harbor contaminating materials. And it's so easy to clean and keep clean that it not only saves cleaning-labor but reduces costly equipment shutdowns.

When you add Stainless' inherent cleanliness to its many other advantages . . . high structural strength with minimum weight, exceptional resistance to high temperatures and to all forms of corrosion . . . you'll often find it's poor economy to even consider any other material.

Most modern, progressive plants use as much Stainless Steel as possible and constantly look for more places to put its cost-cutting advantages to work. And to obtain the finest performance, many of these plants are careful to specify "U·S·S Stainless Steel" for their new equipment.

This perfected, service-tested material is available in forms, grades and finishes to meet almost every requirement. By specifying U·S·S Stainless Steel, you make sure of getting Stainless Steel of the finest possible quality, specifically designed to meet your particular operating conditions.

AMERICAN STEEL & WIRE COMPANY, CLEVELAND · CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO · NATIONAL TUBE COMPANY, PITTSBURGH · TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

U·S·S STAINLESS STEEL

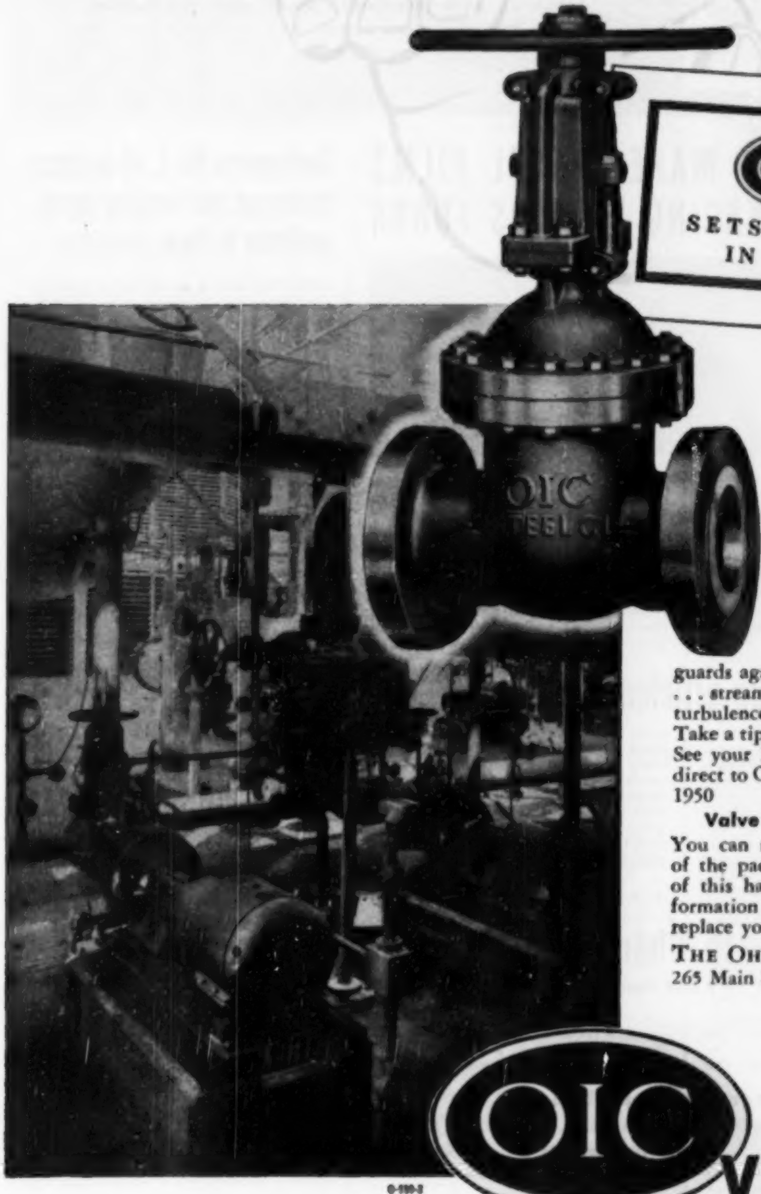
SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

0-1821

UNITED STATES STEEL

Serving

THE PACE-SETTERS OF INDUSTRY



OIC SETS THE PACE IN VALVES

SHELL CHEMICAL Corporation uses these OIC gate valves on fluid transfer equipment at its Deer Park, Texas plant. The famous OIC free-flow feature guards against disastrous pressure-drop . . . streamlined designs protect against turbulence, reduce vibration and wear. Take a tip from the leaders of industry. See your local OIC distributor. Write direct to OIC for your copy of the new 1950

Valve Cross Reference Chart

You can make your trial applications of the pace-setting line with the help of this handy chart. It offers you information on the *right* OIC figures to replace your present valves.

THE OHIO INJECTOR COMPANY
265 Main St. • Wadsworth, Ohio

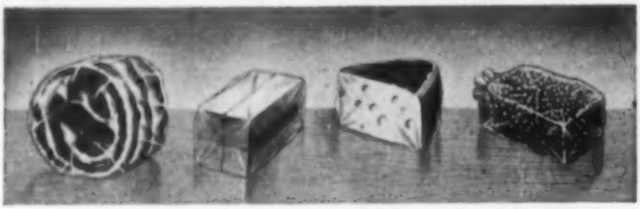
OIC VALVES

FORGED STEEL • CAST STEEL • IRON • BRONZE

For Your Information

Every month Monsanto publishes these pages of pertinent information, selected to help you improve your products, lower your production costs, increase your sales.

SANTICIZER 141 MAKES VINYL FILMS SAFE FOR PACKAGING VARIOUS FOODS



Acceptance of Santicizer* 141 by the Meat Inspection Division of the Bureau of Animal Industry, U. S. Department of Agriculture, as a nontoxic plasticizer for use in plastic products which may come in contact with meat, opens the way for the production of vinyl films that will bring improved packaging to margarine, meat, cheese, cranberries and numerous other food products.

In addition, the approval is assurance of the nontoxicity of Santicizer 141 in *any* application where such quality is desirable. Other qualities delivered by Santicizer 141 include: 1. Flame resistance. 2. Softness and drape. 3. Resistance to weather. 4. Low-temperature flexibility. 5. Light stability. 6. Low volatility. 7. Resistance to embrittlement. 8. Strength, elasticity and abrasion resistance. In many cases, Santicizer 141 improves processing.

Emulsifiers step up efficiency of sprays

Insecticides, fungicides and herbicides can be used more efficiently, with economy and a minimum of effort, through the use of Monsanto emulsifiers and wetting agents.

Most toxicants used in formulations of herbicides, insecticides and mothicides cannot be dissolved in water. The practice is to concentrate these toxicants in oil or an organic solvent and to use relatively small amounts of the formulations in water for spraying. Adding Monsanto emulsifiers and wetting agents to the formulations results in excellent emulsions that spread more evenly and have better adherence. If you are a formulator, mail the coupon for a free copy of Technical Bulletin No. P-142.

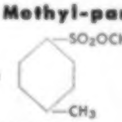
Research Chemists' Corner

You may find something new here

If you are interested in new chemical discoveries, have a look at the specifications of Methyl-para-Toluenesulfonate. The specifications may suggest research that will lead you to the development of a new chemical product . . . or the improvement of an existing product. If you want further information or a sample, mail the coupon.

Methyl-para-Toluenesulfonate

Structural Formula:



Molecular Weight: 186.22

Properties:

Crystallizing Point:	Approx. 25° C.
Color:	Approx. 100 APHA
Chlorine:	0.01% Max.
Acidity as TSA:	0.01% Max.
Saponification Value	186.0 — 187.5
Sp. Gr. at 25/25° C. (super-cooled liquid)	1.225 — 1.227

Suggested Uses: Dye intermediate, alkylating agent, catalyst for alkyd and other organic ester preparations, photographic chemicals, and pharmaceutical intermediate.

Santomerse No. 1, all-purpose detergent and wetting agent, available in three densities

Extensively used as an ingredient in industrial cleaning compounds and as a wetting agent and surface-active agent, Monsanto Santomerse* No. 1 now is available in three densities. These include a granular Santomerse No. 1, designed especially for easy mechanical blending.

Santomerse No. 1, which contains a minimum of 40% active material, does a thorough job of cleaning. It lifts out particles of grease and grime and holds them in suspension so that they cannot be redeposited. Santomerse No. 1 rinses out easily and thoroughly. It is effective in hard or soft, hot or cold water and in acid, neutral or alkaline solutions. It has been found effective in temperatures ranging from below zero to above the boiling point.

For additional information on Santomerse No. 1, mail the coupon or contact the nearest Monsanto Sales Office.

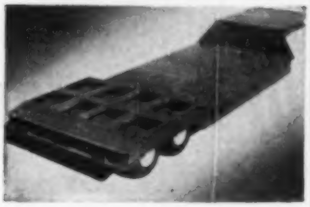
HB-40 cuts plasticizer cost in clear vinyl film

Monsanto HB-40 (partially hydrogenated terphenyl) is practically water-white, making it attractive for plasticizing vinyl films that are transparent or which are to be brilliantly colored. Since HB-40 is extremely low in cost and since it can replace substantial amounts of the primary plasticizer, it can be used to reduce production costs. This savings in costs can be attained without a reduction in quality.

HB-40 is low in toxicity, gives a dry "hand," increases tensile strength, has excellent electrical properties and is highly resistant to moisture. It is nonmigratory.

HB-40 gives excellent results in extrusions, organosols and vinyl injection moldings as well as in films. For further information, mail the coupon or contact the nearest Monsanto Sales Office.

Penta protects deck of 54-ton trailer



The deck of this 54-ton, drop-frame trailer has to be strong . . . and stay strong. That's why its manufacturer, La Crosse Trailer Corporation, La Crosse, Wisconsin, protected the 2½" oak decking with a formulation of Monsanto Penta (pentachlorophenol). Penta protection is a clean treatment that guards wood against termites and other wood-boring insects . . . against the attack of fungi that cause wood decay. Penta can be applied by brushing, dipping or pressure methods. It is a chemically stable treatment that cannot be washed away by rain or ground water. Properly formulated penta treatment leaves wood paintable. If you have a problem of wood preservation, it will pay you to investigate Monsanto Penta. For further information, mail the coupon or contact the nearest Monsanto Sales Office.

Mold in soap wrappers stopped by Santobrite

For as many years as manufacturers have been wrapping bar soaps, they have been plagued by the action of fungi in their wrapping papers. The use of as little as 2.0% (on weight of casein in size) of Santobrite* (sodium pentachlorophenate, technical) controls these microorganisms in casein-coated papers. The addition of Santobrite in the paper stock and in the glues used for sealing also is recommended.

Investigate the possibilities of Santobrite as a means of solving your problems of mold in soap wrappers. For further information, mail the coupon or contact the nearest Monsanto Sales Office.

FOR YOUR LIBRARY

Timely Monsanto publications, listed below, will be sent to users of chemicals on request . . . free and without obligation. Indicate the literature you want on the coupon.

• • •

Technical Bulletin No. O-33—Contains information on Santolube* 31, an additive for use in hydraulic oils, rust preventives, cutting oils, stationary engine lubricants and others.

• • •

Technical Bulletin No. O-52 — Describes Niran,* Monsanto's parathion, an agricultural insecticidal chemical.

• • •

Technical Bulletin No. O-62—Giving information on Santolene* C, a newly developed metal corrosion inhibitor for light petroleum products.

• • •

Technical Bulletin No. P-133—Gives data on Sterox* SE and Sterox SK, 100% active, liquid, nonionic-type, surface-active agents, wetting agents, emulsifiers and detergents.

• • •

Technical Bulletin No. P-129—Presents technical data on Sterox CD, a nonionic-type, liquid, 100% active emulsifier, detergent, surface-active agent.

• • •

Technical Bulletin No. O-16—Featuring Santomask* II for "after-odor" control of paint, printing ink and other compositions.

• • •

Technical Bulletin No. O-D-601—Data on OS-16, flame-resistant hydraulic fluid.

• • •

Technical Bulletin No. P-146—Describing the use of Santomerse S for metal processing in acid media.

• • •

Technical Bulletin No. P-101—Featuring SA-326, an antioxidant for soaps.

New furnace steps up phosphorus production

A new electric furnace, world's largest, is being built by Monsanto Chemical Company at Monsanto, Tennessee, where the company produces phosphorus of better than 99.9% purity. Monsanto converts phosphorus into phosphoric acid and various phosphates.

Here's a new service for the food industry

A new laboratory to study the application of chemicals in foods has been set up by Monsanto at Anniston, Alabama, and is ready to work on such problems for the food industry. There is no charge for investigational work by the laboratory, one of the few such establishments in the chemical industry.

The illustration shows Dr. Roy E. Morse, food technologist, conducting an experiment in tomato canning. For further information, mail the coupon.

*Reg. U. S. Pat. Off.

MONSANTO CHEMICAL COMPANY, 1702-G South Second Street, St. Louis 4, Missouri. District Sales Offices: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

INFORMATION: ☐ Santicizer 141. ☐ Santomerse No. 1. ☐ HB-40. ☐ Penta. ☐ Santobrite. ☐ Food Laboratory.

LITERATURE: ☐ Bulletin P-142 (Emulsifiers). ☐ Bulletin O-33 (Santolube 31). ☐ Bulletin O-52 (Niran). ☐ Bulletin O-62 (Santolene C). ☐ Bulletin P-133 (Sterox SE & SK). ☐ Bulletin P-129 (Sterox CD). ☐ Bulletin O-16 (Santomask II). ☐ Bulletin P-146 (Santomerse S). ☐ Bulletin P-101 (SA-326). ☐ Bulletin O-D-601.

SAMPLE: ☐ Methyl-para-Toluenesulfonate.

MONSANTO CHEMICAL COMPANY
1702-G South Second Street
St. Louis 4, Missouri

Please send information indicated at the left.

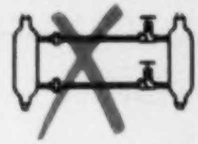
Name...Title.................

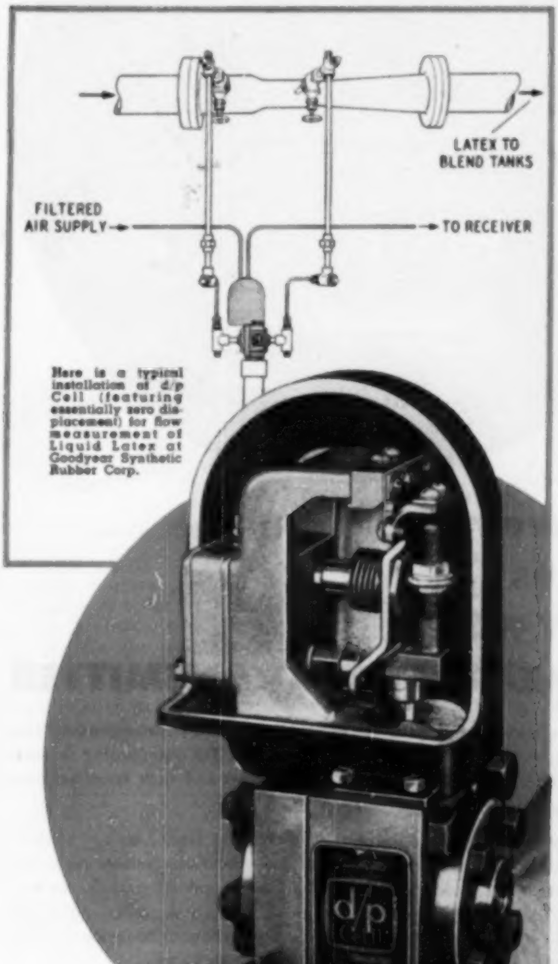
Company..

Street...

City......................................Zone.......State...............

NOW — measure flow of viscous or corrosive fluids without seal pots





Here is a typical installation of d/p Cell (featuring essentially zero displacement) for flow measurement of Liquid Latex at Goodyear Synthetic Rubber Corp.

You can cross seal pot troubles right off your list when you measure the flow of viscous or corrosive liquids with a Foxboro d/p Cell (differential pressure pneumatic transmitter). Goodyear did it very successfully on one of the toughest jobs . . . the control of latex flow to a coagulator. Here are the results obtained by this leading manufacturer through the use of the mercuryless d/p Cell:

A. 83% reduction of instrument cleaning and maintenance costs.

B. No unscheduled production shut-downs for instrument maintenance.

C. Estimated savings over previous flow measuring system will return cost of d/p Cell installation in approximately 1 year.

These cost-saving achievements were made possible by the elimination of seal pot disadvantages . . . (frequent and time-consuming clean-outs, constant risk of clogging, instrument inaccuracies, etc.). A complete "Technical Report on Savings Effected at Goodyear Synthetic Rubber Corporation through Control of Latex Flow by d/p Cell" is available. Send for a copy and details of the unique d/p Cell. The Foxboro Company, 248 Neponset Ave., Foxboro, Mass., U. S. A.

FOXBORO
REG. U. S. PAT. OFF.

d/p CELL
for better flow measurement

Tri-Clover
STANDARD SERIES
SANITARY TYPE
Tri-Clover
"PUMP KING" SERIES
SANITARY TYPE
Designed for very efficient operation at 1800 and 3600 RPM, and especially where high speeds are required, through heaters, coolers, filters, clarifiers, etc. The 3600 RPM model is especially applicable in the dairy industry where high head and low capacity are essential, and for handling low and medium viscosity liquids in the food processing industry.
Tri-Clover
offers you
A COMPLETE LINE
of non-clogging
CENTRIFUGAL PUMPS
for dairy and food processing
chemical · bottling
general industrial
Tri-Clover
STANDARD INDUSTRIAL TYPE
A popular model in the general industrial field for pumping water, brine, light oils, chemicals or paints. Available with I.P.S. screwed or flanged connections.
Tri-Clover
HEAVY DUTY
INDUSTRIAL TYPE
WRITE FOR NEW CATALOG
Tri-Clover
MACHINE CO.
Kenosha, Wisconsin
TRI-CLOVER PUMPS WILL HANDLE ANY PRODUCT THAT WILL FLOW TO THEM

TOPS IN TOUGHNESS! Many process industries think of Hercules ethyl cellulose first when they want strength and economy. In one form or another, this versatile cellulosic material has successfully handled many other tough product problems.

Ethyl cellulose flake is used to strengthen phonograph records. Solutions of this material provide durable, quick-setting plastic peel to protect hardware; weather-resistant cable coatings; marproof furniture lacquer; heat-sealing finishes, and laminating adhesives for paper and paperboard. Printing inks of many types also owe their durability and quick dry to ethyl cellulose.

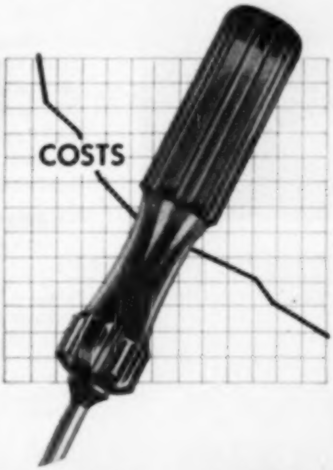
Whether your problem concerns plastics or some other material where the toughness of the cellulose chain could be useful, Hercules welcomes the opportunity of placing its long experience in cellulose chemistry at your disposal.

HERCULES POWDER COMPANY 952 Market Street, Wilmington, Delaware
Sales Offices in Principal Cities

"DRESINOL," "HERCOCEL," "HERCOFLEX" AND "VINSOL" ARE HERCULES TRADE-MARKS

RESULT...

. . . colorful, permanently attractive tool handles that are not only super-tough, but non-conductive and economical to mold or fabricate. Their use by the automotive and other industries has meant a marked decrease in replacement costs.



Hot Lacquer is Hot News

Wearing hot-lacquer coats, a group of new and old cars is providing Hercules with a mobile proving ground for the relatively new technique of spraying high-solids lacquers at elevated temperatures. Furniture manufacturers also are rapidly adopting the process.

Heat, rather than high solvent content, makes the lacquer fluid enough for spraying. Less solvent and higher solids mean thicker films when dried, fewer coats required, increased production capacity, and minimum rubbing.

Write for folder, "The Case For The Hot-Lacquer Process".

The Case for Casein

Supreme among water adhesives because of their water resistance and dry bond strength, casein glues are finding added uses in the packaging industry. One of the oldest applications is for affixing beer bottle labels. The latest important use is for gluing the paperboard beer cases themselves. Here, a bond is provided which is strong enough to withstand handling and shipping yet easily released when the case is opened. Hercules is a major supplier of casein to the adhesives industry.

New "Hercoflex" for Vinyls

"Hercoflex" 290 (octyl decyl adipate) is the third in a series of vinyl plasticizers to be announced within recent months by Hercules. Possessing the low volatility usually restricted to phthalates, this adipate-based ester contributes exceptional low-temperature properties and improved "drape" to vinyl film and sheeting.

Rubber Latex Extenders

Hercules Dresinols®—a series of resin emulsions—find increasing use as extenders and modifiers for synthetic and natural rubber latices. They offer a wide variety of film properties, high water resistance, and other typical resinous characteristics. Their use is indicated in many industries where water-dispersible resins are desired.

More Durable Concrete

Hercules neutralized Vinsol® Resin (NVX) is widely used for producing air-entrained concrete . . . a concrete which is more durable under freezing and thawing conditions, is more uniform, more workable, and has improved surface texture. It can be interground with cement at the mills or added to the concrete mix at the mixer.

ROSIN AND ROSIN DERIVATIVES · CHLORINATED PRODUCTS · AND OTHER CHEMICAL MATERIALS FOR INDUSTRY

GC50-4

"How to get new steam traps *for free*"

Trade steam losses for them . . .

Cost of Steam Leaks at 100 Pounds Pressure
(Assuming steam costs 50 cents per 1000 lbs.)

Size of Orifice	Lbs. Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2"	835,000	$417.50	$5,010.00
3/8"	470,000	235.00	2,820.00
1/4"	210,000	105.00	1,260.00
1/8"	52,500	26.25	315.00
1/16"	13,200	6.60	79.20
1/32"	3,400	1.70	20.40

30% FUEL SAVINGS after installing 15 Armstrong traps on expeller troughs.—*Pacific Nut Oil Co., Los Angeles, Calif.*

IT COSTS far more to live with leaky steam traps than it does to replace them with Armstrongs — the traps that pass no steam. Measure their cost against steam losses caused by traps that let steam get by (see left).

In Armstrong traps the discharge valve is water-sealed at all times—no steam gets to it. There's no chance for dirt to hold the valve open and let steam escape. Armstrong traps don't COST money, they SAVE money. Ask your nearby Armstrong representative to figure on the traps you need now.

ARMSTRONG MACHINE WORKS
858 Maple St., Three Rivers, Mich.

SEND FOR THE STEAM TRAP BOOK. It tells how to figure condensate loads, how to select traps. Includes prices, data, capacities of Armstrong Steam Traps. Write for your copy.

ARMSTRONG STEAM TRAPS

A Headline that is also a Helpline!

① BUFLOVAK Evaporators ② Profitably used for By-Product Recovery ③ Produce Salable Products from Waste Materials ④ Which Put Dollars In Your Pocket ⑤ And Solve Disposal Problems

1. BUFLOVAK Evaporators are engineered to profitably meet the individual plant condition and built in many types, sizes and materials of construction.
2. They are successfully used for the recovery of by-products; such as, stillage, pickle liquor, black liquor, whey, mercerizing liquor, sulphite waste, steep water, and other valuable wastes in many industries.
3. Such products are converted into salable or reusable materials by efficient evaporation methods. Some by-products are also dried with BUFLOVAK Equipment.
4. It's a new source of added profits. And, it puts additional dollars in your pockets through savings in steam and cooling water, that come from multiple effect evaporation economies.
5. Disposal problems are profitably solved; and stream pollution is prevented.

Send for Catalog No. 351

Buflovak Equipment

DIVISION OF BLAW-KNOX CO.

[illegible] AVE., BUFFALO 11, N.Y.

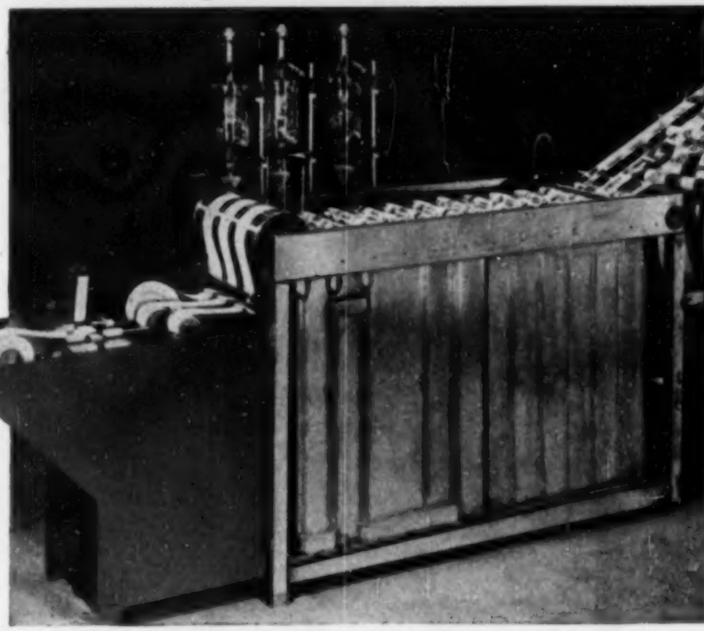
The above illustration shows BUFLOVAK Evaporators used in the recovery of zinc sulphate and zinc chloride from pickle liquor. The evaporators are equipped with patented Salt Separators.

P.S.

RESEARCH AND TESTING LABORATORY

To assist you in the solution of processing problems, BUFLOVAK offers the facilities of its Research and Testing Laboratory . . . where small scale experimental units show you, before you buy, the commercial possibilities, data on production cost, and characteristics of the finished product.

Enduro STAINLESS STEEL



Chemically-resistant ENDURO *insures process accuracy and product purity—wherever it is in contact with a product in process. Its immunity to most acids and alkalies, to rust and corrosion, to high heat and low cold—make ENDURO a doubly sound investment!*

SPEEDS PHOTO-FINISHING PROFITS

"The answer to a photographer's prayer," says a prominent chemist and metallurgist concerning ENDURO Stainless Steel.

It offers high corrosion-resistance to photographic solutions—developers, washers, inhibitors. There is also no contamination of photographic chemicals, for Enduro is chemically inert and possesses a smooth, pore-free, sanitary-as-glass surface.

Among its many important applications in the photographic field is the "100% stainless steel" continuous photo print machine illustrated. Multiplied rate of output, continuous production economies and new profits have been added to photo finishing.

So too, the making of silver nitrate crystals was a hand operation until conversion to mass production through use of stainless steel.

Wherever chemistry contributes to industry—foods, industrial chemicals, processing—there ENDURO can contribute substantially to PROFITABILITY. May we send you the details?

CHECK ALL 12 ADVANTAGES: Rust- and Corrosion-Resistance • Heat-Resistance • High Melting Point • Low Coefficient of Expansion • High Strength • Good Dimensional Stability • No Metallic Contamination • Easy to Clean • Easy to Fabricate • Eye Appeal • Long Life • Low End Cost • *What more can be desired in a material?*

REPUBLIC STEEL

For Complete Details Write

REPUBLIC STEEL CORPORATION

Alloy Steel Division, Massillon, Ohio • GENERAL OFFICES, CLEVELAND 1, OHIO • Export Dept.: Chrysler Bldg., New York 17, N.Y.

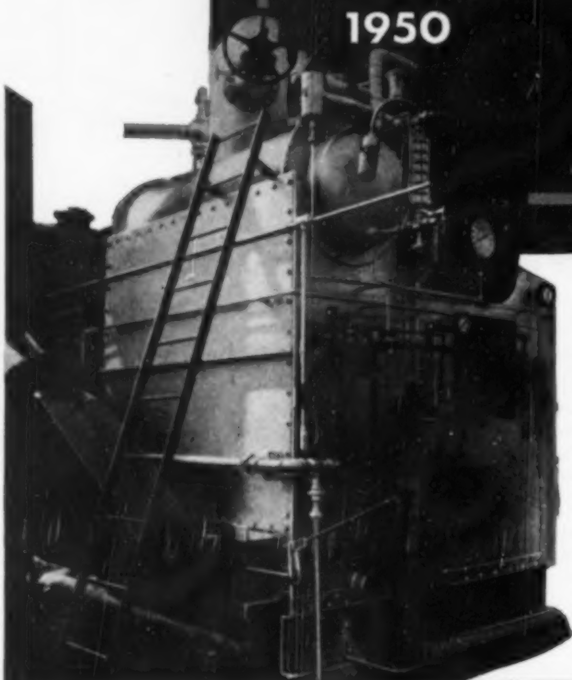
Serving
process industries *everywhere*

Foster Wheeler
DOWTHERM
Vaporizers for Process Heating

ONE BILLION Btu
per hr
TOTAL CAPACITY

in **303** units—
sizes ranging from
50,000 to 50,000,000
Btu per hr

1950



Increased quality and production are assured in many widely diversified industries employing Foster Wheeler Dowtherm Vaporizers which provide process heating with precise uniformity over a wide range of high temperatures.

For further details, write...
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

Drip Proof

Splash Proof

Totally Enclosed Fan Cooled

Explosion Proof

ALTERNATING CURRENT MOTORS

POLYPHASE

Squirrel Cage Induction — 1/6 to 400 H.P.
Wound Rotor Motors—1 to 400 H.P.
Synchronous Motors—20 to 150 H.P.

SINGLE PHASE

Split Phase Induction—1/6, 1/4, 1/3 H.P.
Capacitor—1/6 to 20 H.P.
Repulsion Start, Brush Lifting, Induction—1/2 to 20 H.P.

DIRECT CURRENT MOTORS

1/6 to 300 H.P.

GENERATORS

AC, .63 to 250 KVA
DC, .75 to 200 KW

GEAR MOTORS

1/8 to 1-1/2 H.P.

MOTOR GENERATOR SETS

AC to DC, AC to AC
DC to DC, DC to AC

Open Protected, Splash Proof, Totally Enclosed Fan Cooled, Explosion Proof.

Ball Bearing motors are factory lubricated for several years' normal service. Bearing housing construction permits easy re-lubrication when unusual service demands it.

CE-673

To guard your production against the destructive effects of atmospheric hazards, Century offers four types of protective motor frames.

DRIP PROOF—meets the requirements of most installations. Use it where operating conditions are relatively clean and dry. Top half of the frame is enclosed to keep out falling solids and dripping liquids.

SPLASH PROOF—keeps splashing liquids out of the motor even when the frame is washed with the full force of a hose. Use Century Splash Proof motors indoors or outdoors.

TOTALLY ENCLOSED FAN COOLED—resists the hazards of abnormal concentrations of dusts, powders, grit, oil mists, acid and alkali fumes.

EXPLOSION PROOF—protects life and property in atmospheres charged with explosive dusts or vapors.

The properly selected protection with the wide variation of starting torque characteristics to choose from provides long operating life and improves the production of the driven equipment.

Century motors are available in a wide range of kinds and types—in sizes from 1/6 to 400 horsepower—for single phase, polyphase and direct current applications.

Specify Century motors for all your electric power requirements.

CENTURY ELECTRIC CO. 1806 Pine St. • St. Louis 3, Mo.

Offices and Stock Points in Principal Cities

TO KEEP structural steel walls and ceilings free from attack by corrosive fumes and gases — paint them with TYGON PAINT.

This chemically inert plastic goes on like paint, air dries quickly, forms a tough, durable, "live" plastic film that provides continuing protection against corrosion long after the failure point of the best oil-base paints.

Tygon Paint will handle effectively the fumes and gases of almost all acids and alkalies, and at temperatures as high as 190°-200° F. It will not oxidize; neither will it crack, craze, check or "alligator."

And with Tygon Paint you're not limited to dull blacks, drab greens or grays. Tygon Paint is available in a wide range of sparkling clean colors, including white.

Write today for a free test panel of Tygon Paint. Hang it in your plant where corrosive fumes are worst. Stack its performance against any competitive coating. We think you, like thousands of others, will standardize on TYGON. *Address your requests to Plastics and Synthetics Division, The U. S. Stoneware Co., Akron 9, Ohio.*

U. S. STONEWARE

SPECIALISTS IN REDUCING PLANT MAINTENANCE COSTS THROUGH MORE EFFECTIVE MEANS OF CORROSION CONTROL

THE *Chementator*

Reg. U. S. Pat. Off.

AN APPRAISAL OF TREND-MAKING NEWS IN THE CHEMICAL PROCESS INDUSTRIES

Prepared under the editorial direction of Joseph A. O'Connor, News Editor

Westvaco: into the phosphorus big time

A third electric furnace for the production of elemental phosphorus will be constructed for the Westvaco Chemical Division of Food Machinery & Chemical Corp. at its Pocatello, Idaho, plant, where two phosphorus furnaces are now in operation. Bechtel Corp. expects to have the new furnace built by late spring of 1951. By then, Food Machinery will have pumped close to $15 million into Pocatello. When all three furnaces are producing, the plant will be able to turn out roughly 30,000 tons of elemental phosphorus a year. At this rate, it won't be many years before Westvaco is crowding Victor and Monsanto for supremacy in phosphorus.

Power will come from the hydroelectric system of the Idaho Power Co., phosphate rock from nearby deposits on the Fort Hall Indian Reservation. The phosphate rock is supplied under a long-term contract by J. R. Simplot, who has 2,400 acres under lease at Fort Hall. Reportedly, Simplot once turned down an offer of $5 million for his fertilizer holdings. But don't be surprised if he sells his leases and mineral rights to the phosphate rock at Fort Hall to Food Machinery before long. Thus integrated back to the phosphate rock, and with its vast trona deposits at Westvaco, Wyo., Westvaco is fast becoming the dominant producer of fertilizer ingredients and chemicals in the booming Intermountain area.

Westvaco is also carrying its integration in the other direction, closer to the consuming industries. At Lawrence, Kan., a plant will be erected for the processing of phosphorus into soluble phosphates for the soap, textile, oil and chemical industries (see *Chementator*, June 1950, p. 80). According to Bechtel Corp., it is slated for completion by spring of 1951. The site, on the Kansas River some 35 mi. west of Kansas City, Mo., was picked not only as a likely spot for a phosphate unit but also with an eye toward future expansion into other chemical operations.

Chemical industry urged to tell its story

Chemical industry's chief task is to increase public awareness of its efforts in fighting air and stream pollution, improving safety records, lengthening lives and "serving humanity in countless ways," asserts MCA President George W. Merck.

Merck, who is chairman of Merck & Co., Inc., says the industry's accomplishments in these fields could be largely overlooked unless the public is shown that "we are doing the right thing."

Because of the industry's rapid growth, Merck points out, most of its members fail to realize that "we are about the largest one in the United States today." This imposes an even greater responsibility, he says, to "see to it that we deserve and gain a high opinion in the minds of the people."

Let industry tackle nuclear power

Give the job of developing nuclear power to industry, urges Charles A. Thomas, executive vice president of Monsanto, and give the job to industry immediately. Specifically, Dr. Thomas suggests that a 75,000-kw. power plant could be built in Idaho to provide electric energy for production of phosphorus.

His plan includes AEC supervision of uranium and the recapture of plutonium. For the production of plutonium, industry would get a fee to help offset the cost of power. Even so, the government would be getting its plutonium cheaper than it can be produced at the government plant at Hanford, Wash. Thus his plan suggests a way of meeting the great initial cost of full-power reactors, which is estimated at from $20 million to $100 million.

While some of the biggest U.S. corporations now operate AEC plants, they do so as contractors. Hence they have little opportunity to work on their own with free rein, private capital and American technological genius.

Chemical industry opposes tariff cuts

Representatives of major chemical producers appeared before the Committee for Reciprocity Information in Washington recently to give the government their opinion on tariffs. They were unanimous in their opposition to any cuts in import duties.

The committee is gathering information for use when reciprocal trade agreements are discussed at Torquay, England, this fall. At that time 17 nations will meet with representatives of this country to consider American tariff reductions.

Under the Reciprocal Trade Act, the President

(Continued)

has the authority to enter into tariff negotiations with other countries for the reduction of tariffs. He can cut tariffs up to 50 percent of the existing rates. In 1947, the U. S. and several foreign countries agreed to reduce tariffs on many items. More tariffs were reduced in the summer of 1949. The Torquay conference will be a "third round" in tariff cuts.

A large number of chemical items are being considered for tariff cuts. A number will run the risk of losing any tariff protection whatever.

Within the scope of the items proposed for tariff reduction, for example, is a list of 200 chemical compounds manufactured by Dow. Only 37 of these products are mentioned by name in the tariff. The rest are included either by class or derivation.

U. S. Industrial Chemicals recommends that tariff duties on the following chemicals in particular should be maintained at existing levels: synthetic resins, acetic acid, acetaldehyde, butyraldehyde, ethylene glycol, acetone, methyl ethyl ketone, amyl alcohol, fusel oil, butyl alcohol, propyl alcohol, ethyl ether, and collodion and other pyroxylin solutions.

A reduction in the tariff on phenol, for example, which would permit foreign producers to export phenol into the United States, might force American producers out of business and all United States industries that use phenol might become dependent on foreign producers. Phenol, a highly critical material during World War II and an essential building block of the chemical industry, can be produced in low wage scale countries at costs substantially lower than in the U. S. The average wage rate paid by Dow, as an instance, is approximately 360 percent that of the rates in Great Britain for companies that are producing competitive chemicals.

Tariff cuts are opposed at this time for three major reasons: (1) they will lead to unemployment; (2) retard the technological and economic development of the nation; and (3) weaken the national defense.

Donald K. Ballman of Dow, in his appearance before the committee, stated that the ability of the U. S. to remain self-sufficient in synthetic rubber and many other strategic materials might depend upon the government's tariff policy. Reduction in tariffs would also weaken national defense.

"The best in fuel, lubricants, alloys, equipment, medicine, protective clothing, and explosives are created by aggressive research supported by the chemical industry," Ballman said.

"The American chemical industry must keep pace with the times. New materials must not be developed and manufactured only on the other side of the ocean. The American chemical industry must not be placed at such a disadvantage that it cannot afford to do the research and development necessary before new products are brought to the market. Money won't be invested for new plants if there is no opportunity for the American producer to sell," Ballman further declared.

President William M. Rand of Monsanto, who is also chairman of the Manufacturing Chemists' Association, charged that reduction of American tariffs at this time would stimulate still further the construction of more and more chemical plants within the Russian orbit and in areas subject to seizure or control by the Soviets.

"Foreign competition is unfair when state-controlled industries employ slave labor, currency devaluation, exchange rate juggling, state trading and other ruthless trade practices which are not and cannot become a part of our system of free competition among private enterprises," Rand said.

Expressing sympathy with any movement that would promote international trade, Rand added that foreign markets would be of little consequence if America's domestic economy was adversely affected.

"Our first obligation to the world is to maintain our domestic economy and full employment," he warned.

Industry spokesmen believe that any reduction in chemical tariffs will result in the encouragement of plant construction or expansion in areas now dominated by or subject to being overrun by powers whose avowed goal is world domination.

Importance of chemicals in the national economy was stressed by industry representatives. The chemical process industries represent the largest single segment of American industry, being larger than food or iron and steel.

"In time of national emergency," Rand pointed out, "the role of chemicals is even more significant.

"History shows that this country was utterly dependent upon foreign supply of organic chemicals at the time of World War I. The last war found us in a far stronger position. Under the tariff protection which was fostered in the 1920's and 30's, the organic chemical industry was able to develop intensively. It grew to the point where it supplied our entire domestic requirements—and most of our allies—and made victory certain in the most highly scientific war yet fought."

Pensions the sorespot in Solvay strikes

Pension demands of workers touched off strikes in mid-June that closed plants of Allied's Solvay Process Division. Strikes began on June 13 at Solvay plants in Syracuse, N. Y., Detroit, Mich., and Baton Rouge, La., when members of District 50, United Mine Workers, began picketing.

The strike took 2,000 Solvay employees from their jobs at the Syracuse plant. Andrew Hiznay, field representative of District 50, United Mine Workers, said there was "nothing new" in the walkout. A Solvay

(Continued on page 78)

spokesman at Syracuse, H. Edward Rowlands, assistant to the vice president, characterized the situation as "delicate."

At Baton Rouge, more than 500 production and maintenance workers were on strike. William Bunch, UMW field representative there, said the whole production force was out.

Union and company officials said the strikes were over a \$100 pension plan. The plan sought by the union reportedly is without inclusion of Social Security payments. The pension and welfare plan that the workers want is somewhat similar to that of the coal miners. Workers claim the plan would cost about 8 c. per man-hour above the present scale of \$1.63 to \$2. Wages as such were not involved.

According to James Walsmit, plant manager at Baton Rouge, Solvay already has a plan recently revised upward to equal plans accepted in the automobile and steel industries.

What to do about the benzene crisis?

WAY OUT—Synthetic rubber producers and manufacturers of polystyrene plastics are still scrambling for all too scarce styrene. But it takes benzene to make styrene. And since the coal strike, benzene production has never caught up with demand. Now one new possible way of relieving this situation glimmers on the horizon. It may work.

CUT DOWN ON STYRENE—The rubber companies have come up with the idea. Why not lick the benzene shortage, they ask, by cutting down the amount of styrene that goes into GR-S tire rubber? Change the ratio of styrene to butadiene, they say. One firm has gone so far as to suggest that instead of nearly a third of styrene in the copolymer, the manufacture of GR-S rubber should be based on a 20 percent formula. This would cut back by one-third the need for styrene, and thus the need for benzene.

Before the rubber makers' idea can be tried out, however, the government will have to overhaul its synthetic rubber policy. Up to now, the government has required all copolymer plants to stick to the standard ratio of 29 percent styrene to 71 percent butadiene in the production of synthetic for tires. Thus a uniform product came from all government GR-S plants. This made plant control easier, and it facilitated tire making. Now, however, this policy may have to be changed. The only alternative is to produce less rubber. For there just isn't enough benzene to make the styrene that would be required using the old ratio.

EVEN ELIMINATE IT—Carrying this idea to its limit leads to the manufacture of polybutadiene, a tire rubber made wholly without styrene. Phillips Petroleum has successfully produced polybutadiene rubber by mixing the polybutadiene latex with high-abrasion furnace carbon black before conversion to solid rubber. The new rubber is made at moderately low temperatures; it is much softer than usual. What's more, it can be made in present GR-S plants with no change in equipment. Already, Rubber Reserve has scheduled production of this polybutadiene rubber for use in tires for further road tests.

OR SUFFER SETBACKS—At mid-year, the benzene famine is holding back the development of promising markets for synthetic rubber and polystyrene plastics. Each of these big consumers of styrene needs at least 5 million or 10 million gallons additional to finish out this year at wanted rates of production. Still further growth in manufacture of synthetic rubber and polystyrene plastics is sure for future years, barring a major business setback.

TILL NEW SOURCES OPEN UP—Somehow the chemical process industries of the United States have got to scrape up 1 million or 2 million gallons more per month of benzene. Where this will come from is not yet clear. European sources are being drained by U. S. buyers abroad. Coke-oven manufacture of benzene continues at peak pace. Synthesis from petroleum is growing. Pan American at Texas City can produce 3 million to 5 million gallons a year; Shell at its Wilmington, Calif., refinery is also making synthetic benzene. But high prices hinder volume production from this source. Users might pay 25 c. to 30 c., but most of them balk at 35 c. to 40 c., which petroleum executives think they must ask to recoup their initial investment at a reasonable rate.

For the immediate future, all this adds up to one sure thing: more trouble for the buyer of benzene.

Terylene: Du Pont evaluates it

Whether Du Pont goes ahead with plans for an \$8 million plant to make polyethylene terephthalate synthetic fiber hinges on the outcome of evaluation tests now under way. Both consumer and industrial applications of the new fiber, which Du Pont calls Fiber V, are being evaluated.

Technically, the material is a condensation polymer obtained from ethylene glycol and terephthalic acid. Present production is limited to experimental quantities of continuous filament yarn and staple being turned out at Du Pont's Seaford, Del., plant.

Fiber V has high tensile strength and high resistance to stretching—both wet and dry. It resists abrasion and degradation by chemical bleaches. Most of the fiber's properties are equally good under wet or dry conditions. Fabrics made from Fiber V are resilient; they resist wrinkling, launder easily, dry quickly, and can be heat-set. A wide range of filament deniers is possible. The fiber has good electrical insulating properties; it is not weakened by fungus, mold or mildew.

Du Pont has not decided on a name for Fiber V.

(*Continued on page 80*)

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- Cobalt Trifluoride
- Zirconium Fluoride
- Antimony Pentafluoride
- Tungsten Hexafluoride
- Iodine Pentafluoride
- Titanium Tetrafluoride
- Lead Tetrafluoride
- Ceric Tetrafluoride

*As developed by General Chemical, Sulfur Hexafluoride was the first commercial chemical produced from Elemental Fluorine to be offered to Industry. The unusual thermal and chemical stability of this inert, non-toxic gas, as well as its high dielectric strength, have led to its use as an insulator in high voltage electric equipment; other interesting uses are in the process of development.

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THE CHEMENTATOR, continued

It was first developed in England by the Calico Printers Association, Ltd., and Imperial Chemical Industries, Ltd. In England it is known as Terylene. Du Pont acquired the U.S. manufacturing rights in 1946. Development work by Du Pont, since this acquisition, has all been exploratory. No firm decision to go ahead with commercial production of the fiber has yet been made.

Air pollution: battle of the bureaucrats

A behind-the-scenes tug of war by federal agencies is disrupting efforts of congressmen to get a federal air pollution law on the books. Five such bills are on the congressional calendar. At least three agencies—Public Health Service, Bureau of Mines and Civil Aeronautics Administration—are hungrily eyeing the juicy job of administering any federal air pollution act.

While interested in air pollution, PHS isn't keen on any of the bills under consideration. Instead, it wants a law similar to the water pollution control legislation passed in 1948. Thus it could control the research grants to the states, but it wouldn't have the job of enforcing the law. Enforcement of the federal water pollution law is handled chiefly by the states. As PHS knows, "a policeman's lot is not a happy one." On the other hand, everyone loves someone with an open purse.

PHS goes about getting the law it wants in its own peculiar way. It wants the air pollution problem to be tackled, not by industrial engineers, but by "industrial hygienists." The hygienists consider themselves health workers, hence are more apt to play follow the leader with PHS. Engineers, however, look to the Bureau of Mines.

The PHS Division of Industrial Hygiene caters to the industrial hygienists. Speaking of air pollution, J. J. Bloomfield, assistant chief of the division, recently told hygienists, "I should like to think that we are all agreed that it is the job of the industrial hygienist."

One bill would authorize the CAA to study the need for smog control in the vicinity of airports in order to promote safety in air navigation. PHS objects to this bill on the health reason—the most dangerous smogs are not necessarily those that hamper visibility.

Since there are more industrial hygienists in private industry and state work than in the federal establishments, Bloomfield feels that PHS can safely give up the enforcement to local authorities and yet, through control of people working on the program, control the entire field.

Bloomfield makes no bones about it. "The control of the outer atmosphere is but a short, quick step removed from the control of the inner working environment in which the industrial hygienist is the recognized scientist," he says. "If he refuses now to apply the skills which he has acquired over a long period of years, he will be violating an ethical responsibility."

The Bureau of Mines has been working its end too. Although a national air pollution symposium, the first of its kind, was held in Pasadena, Calif., last year, the Bureau of Mines was one of the active sponsors of the U. S. technical conference on air pollution in Washington last May.

It was agreed at that meeting by most speakers that any control of air pollution must be preceded by research to identify the pollutants and their properties, and to develop sampling and analysis methods. Research must also first determine the chronic effects of exposure so that threshold values of contaminants, similar to the maximum allowance concentrations used in industry, may be developed.

The PHS hopes to enter into air pollution control through the research door. Its Industrial Hygiene Division is already engaged in this research.

Step on the propane, driver

By 1952 at least 20 percent of the nation's urban buses will be using propane. So predicts President L. J. Fageol of the Twin Coach Co., a leading bus manufacturer. "Ultimately gasoline or diesel buses will be as rare on the nation's highways as horses and buggies," he says.

Fageol ought to know. Recognized as the propane pioneer of the bus industry, he's been experimenting with this fuel since 1935. Six years ago he introduced the 10-to-1 compression ratio engine, still the only bus engine expressly designed for propane. Now he's turning out the world's first standard line of propane buses.

How big a dent would this switch make in the U. S. supply of propane? "If all of the nation's urban buses were to suddenly operate 100 percent on propane," estimates Fageol, "their total requirements would be only 625 million gallons annually. Addition of this amount to the present U. S. propane consumption of 2¾ billion gallons yearly would represent a total annual demand of only 3⅜ billion gallons. Petroleum industry authorities now estimate our available supply of propane at 15 billion gallons annually. Obviously, we would still have 11⅝ billion gallons of unused, surplus propane capacity. It is apparent that the day of propane shortages and increased prices is still very far off."

Conversion of leading bus lines to propane is proceeding at a rapid rate, according to Fageol. He states that his company now has propane-powered units on order from 10 large operators and that its backlog is increasing rapidly. Among the major transit cities now using propane are Los Angeles, Wichita, Galveston and Fort Wayne. One big advantage of propane: its exhaust is colorless and odorless. —End

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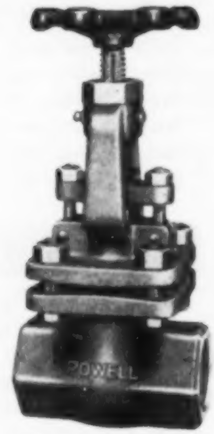
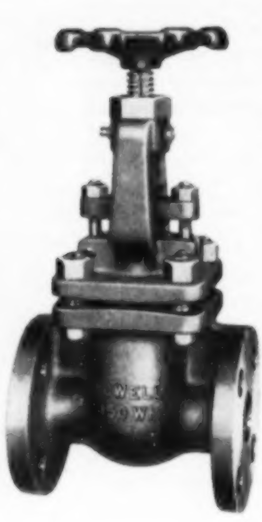
Fig. 1847 — 200-pound Stainless Steel Swing Check Valve with screwed-in cap and regrindable, renewable disc.



New 150-pound Globe Valve with screwed ends, outside screw rising stem and yoke, bolted flanged bonnet. **Fig. 2474** — Available in 18-8S, 18-8S Mo, Durimet "20". **Fig. 2476** — Available in Nickel, Monel, Metal, Ampco Alloy, Everdur, Hastelloy Alloys A-B-C. Flanged End Valves are furnished with face to face dimensions conforming to latest MSS Standards.

Fig. 241 — Large 125-pound Iron Body Bronze Mounted Globe Valve. Sizes 2" to 16", incl. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.



New 150-pound Gate Valve with flanged ends, outside screw stem and yoke, bolted flanged bonnet. Face to face dimensions conform to MSS SP42. **Fig. 2471** — Available in 18-8S, 18-8S Mo, Durimet "20". **Fig. 2473** — Available in Nickel, Monel Metal, Ampco Alloy, Everdur, Hastelloy Alloys A-B-C. These valves are also available with screwed ends.

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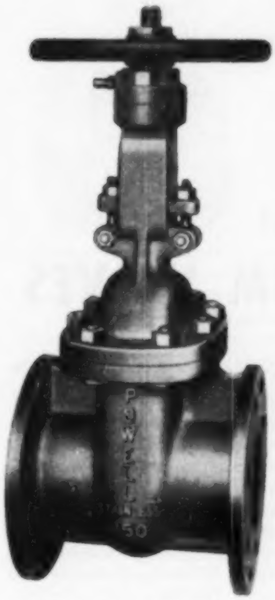

Fig. 2453-G—Standard 150-pound Stainless Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke-bonnet and tapered solid wedge.

Fig. 375 — 200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

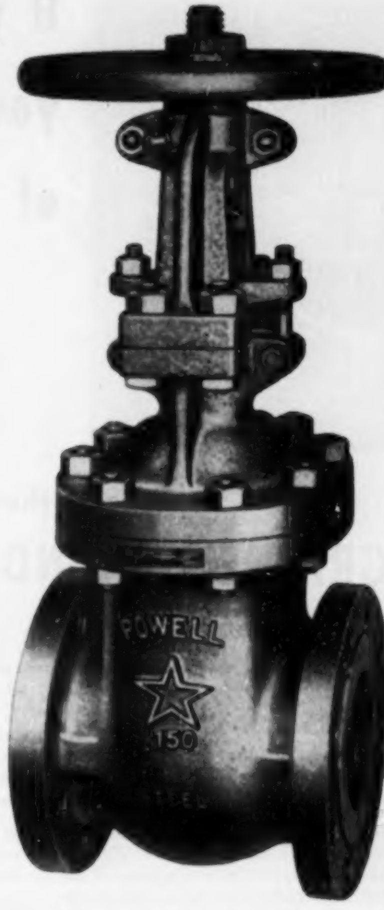

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

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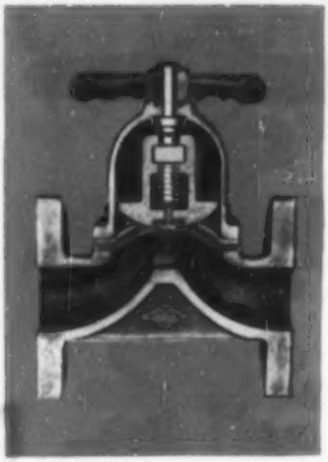

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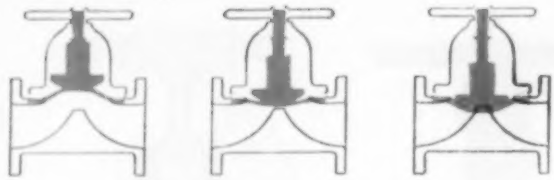

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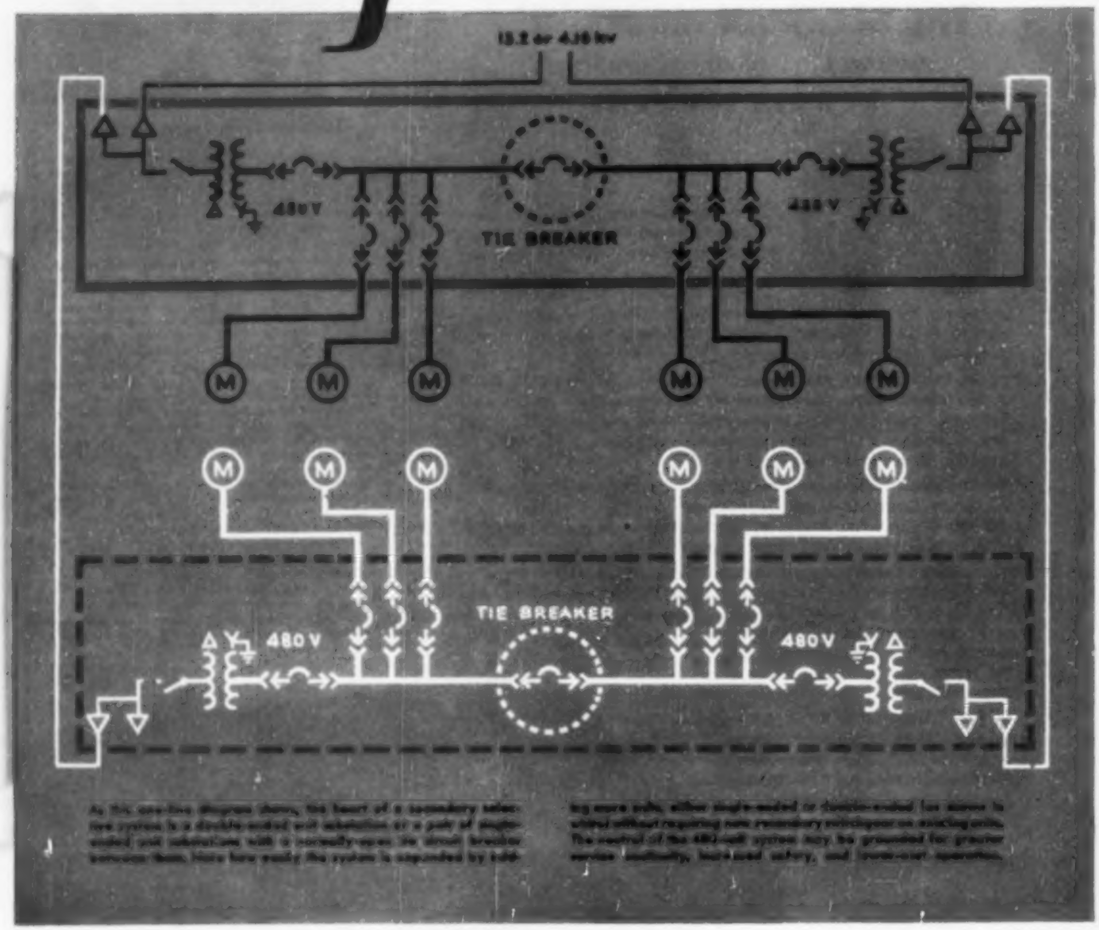

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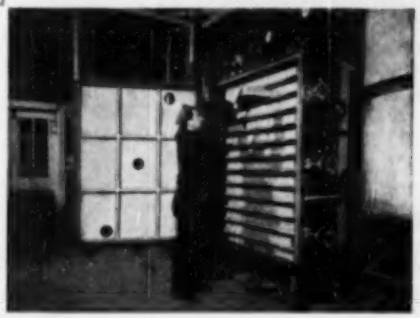

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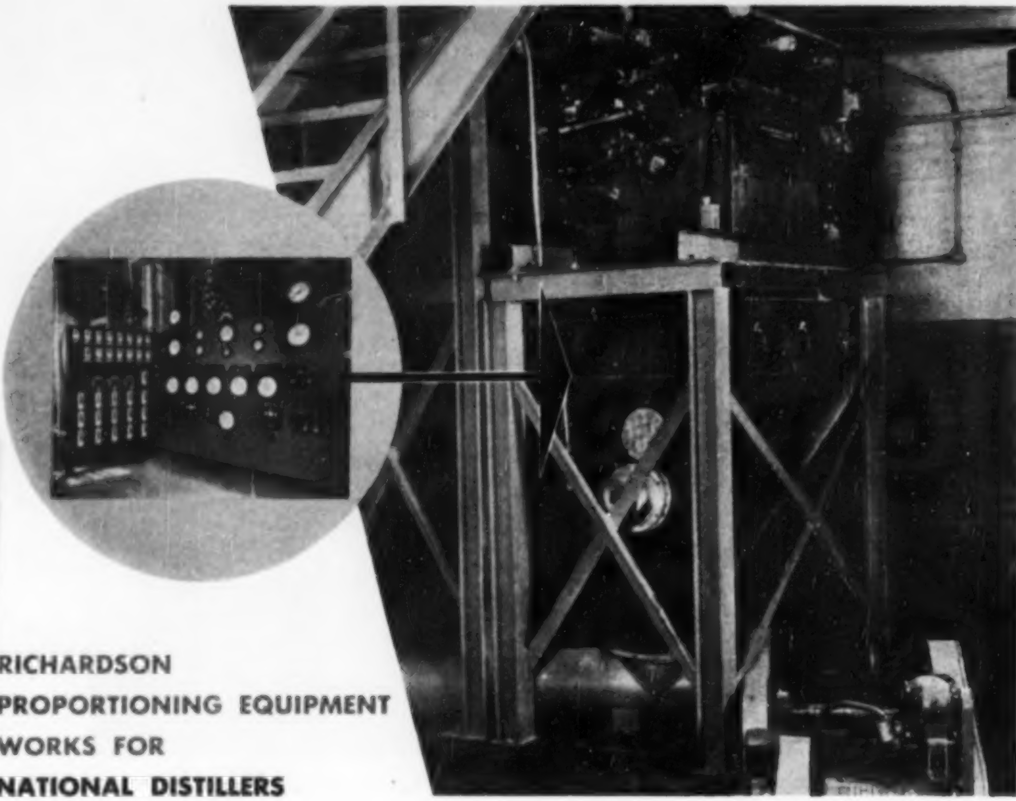

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Water White	x	x	x								
Regular	x	x	x	x	x	x		x			
SM-500	x	x	x	x	x	x		x			
SM-600	x	x	x	x	x	x		x			
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SOYA											
Water White	x	x	x								
Regular	x	x	x		x	x		x			
RO-4	x	x	x		x	x		x			
RO-10	x	x	x	x	x	x	x	x	x		
RO-115	x	x	x		x			x			
CORN-SOYA Double-Distilled				x		x	x	x	x		
CORN Double-Distilled				x		x	x	x	x		
COTTONSEED Double-Distilled		x			x		x	x	x		
COCONUT Double-Distilled		x				x		x		x	

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10 important uses for

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1. **ELECTRICAL INSULATION.** These hydrocarbon polymers are especially important where electrical insulation material must withstand high and low operating temperatures. High dielectric strength and superior power factor characteristics, particularly with respect to aging and elevated operating temperatures, make them extremely useful in this field.

2. **ADHESIVES.** In formulating adhesives, they offer a wide range of variation in control of initial tack, softness, removal characteristics and hot melt viscosity. They are adaptable to all types of mechanical application whether it be hot melt, solvent or emulsion.

3. **METAL PROCESSING.** Stable coolants for rolling, drawing and extruding soft metals such as aluminum, brass, copper. Their stability to oxidation and freedom from residue formation are particularly advantageous in this field.

4. **BODYING AGENTS.** Oronite Polybutenes are very advantageous where formulations require hydrocarbon polymers. Wide viscosity range permits the right degree of bodying. They can be compounded with resins, waxes, oils and fatty acid salts.

5. **WATERPROOFING.** For the formulation of waterproofing coatings with waxes, resins, fatty acid salts, etc., they contribute good moisture resistance, better adhesion and flexibility; reduce cracking and chipping.

6. **PLASTICIZERS AND SOFTENERS.** As plasticizers and tackifiers for rubber and other elastomers and as softeners in leather treatments. Both emulsion and liquid forms of Oronite Polybutenes can be advantageously used.

7. **INSECTICIDES.** For moisture-resistant formulations, compositions which require high resistance to weathering, as excellent carrier of inert filler in paste formulations and tackifier.

8. **INKS.** In the formulation of paste inks and cartridge inks, Oronite Polybutenes have excellent pigment-carrying properties and can be compounded with fatty acids, oils and soaps.

9. **CAULKING AND SEALING COMPOUNDS.** Oronite Polybutenes are soluble in both raw and boiled linseed oil. Their pigment-carrying and non-drying characteristics make them extremely valuable for this use.

10. **AIR FILTERS.** Oronite Polybutenes of differing viscosities are efficient dust-collecting mediums in various makes of air filters.

Oronite Polybutenes are available in different viscosities to answer your specific problems.

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ORONITE CHEMICAL COMPANY

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Memo from the Editor

Our Most-Read Editor

All of you are acquainted with the work of our Senior Associate Editor, T. R. Olive. He is easily our most-read editor—partly because he's been with us 23 years, partly because he produces so much (up to 35 pages in a single issue), but mostly because he writes the sort of stuff you like (such as Plant Notebook, Equipment News, our annual reports on unit operations). He is the man largely responsible for our recent report on Process Energy which has been pulling a lot of praise.

Ted is first and foremost an engineer—precise, reliable, mentally curious. He complains, a little wryly, that his non-technical friends are so impressed with his devotion to the slide rule that they now associate him with slide rules and vice versa.

In his early teens he picked up a Smith motor wheel, one of those little red gadgets you hooked onto a bicycle. His license permitted him to use it on a bike but when he built a buckboard for it, the police drove him off the streets——it had five wheels, you see, and hence was an automobile. But he fooled them the next winter by building a skid chain to fit it and hooked it on a pair of sleds arranged in parralel; then he could make 40 miles an hour over the icy streets of Brooklyn. That rig had only one wheel, so the cops found no way to stop him.

Ted was sixteen when World War I was on and he decided to outdo the patriotic doings of his friends. He put in six months on a Wyoming sheep ranch. That was where he really grew up, he says. In fact, he feels that experience was really responsible for his becoming an editor. His adventures in Wyoming provided him with so much raw material for writing successful high school and college essays that he developed a taste for writing.

His mechanical ingenuity turned out to be pretty handy. When the last ranch hand had been drafted, Ted had to rush him to the railroad station 30 miles away. Exactly midway one of their tires punctured, and there they were—15 miles from either place. They needed something to ignite the vulcanizer with which to patch the ailing tube, but neither of them smoked. It was then that Ted produced one of his proudest (and most timely) inventions. He did the trick with a bit of wire connected to a spark plug, a tin can and some gasoline. The resulting spark ignited the gas and the gas touced off the vulcanizer; the draftee made his train!

Some of the jobs he had to do were hard on his dignity, even if he was only 16. Like the time he had to substitute for a sheep dog. He and another herder had to move 500 quarrelsome buck sheep 35 miles in one day, four times as far as any sheep should ever be moved in a like period. All their dogs had died of coyote poison, and rabies had started a dog embargo. Ted and his companion spent an 18-hour day riding around the herd and barking furiously in imitation of the absent dogs.

Ted then came back east to finish high school and enter Harvard. He changed his mind about oil shale geology and decided to switch to chemical engineering. The fact that the school did not give a course in chemical engineering didn't disturb Ted any. He just made up his own course out of chemistry, mechanical engineering, *Chem. & Met.*, the Chemical Engineering Catalog and Walker Lewis and McAdams.

After getting that AB degree he spent another year in Engineering School and the next four years getting broad and varied experience in the chemical industries. "I literally jumped at the chance to join *Chem. & Met.* in 1927. Here was my chance to combine the two things I most thoroughly enjoyed—writing and engineering."

In the last 23 years Ted has had his hand in just about every type of job the magazine has done. He initiated the diagrammatic flowsheets which first appeared in 1934. One of his principal activities has been in carrying along our tradition of special engineering theme issues. The job that seemed to make the biggest splash was the May 1943 report on measurement and control of process variables. There are many demands for reprints even today, seven years later. There were more than 200 drawings in that issue and he sketched a large proportion of them at his local air-spotting post from 6 to 8 on winter mornings.

In 1935 Ted took the necessary courses and examinations to get a professional engineering license in New York. The state printed 5,000 copies of the chemical engineering examination that year. Ted used one copy; the remaining 4,999 were never used.

Ted is just about our hardest-working editor, but he has found time for a number of outside professional activities. He belongs to several societies and has been particularly active in the ASME. He helped organize the new Process Industries Division and was its secretary for many years. He helped reorganize the defunct Petroleum Division in the middle forties and was its first program and publications chairman. For the last five years he has been a member and is now chairman of the ASME Professional Divisions Committee.

After coming to *Chem. & Met.* Ted developed two more hobbies. Domestic architecture was one. For eight years he drew hundreds of plans and entered two architectural contests against professionals (losing both). When he finally got around to building his first house in 1936 his wife couldn't stand it more than five years. Everything was designed from the standpoint of motion study and it just gave her claustrophobia.

Ted's most beloved hobby right now is boat handling. Anything from an outboard motor up interests him, but he has owned a large cabin cruiser, and now a 30-ft. cruising sloop in his coming-and-going collection. "My eternal problem," he says, "is whether to sell or keep on sailing."

SIDNEY D. KIRKPATRICK, Editorial Director *JOHN C. CALLAHAM, Editor*

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

JULY 1950

Men, Milk and Money

At the dedication last month of the great Long Island laboratories of National Dairy, Dr. Karl T. Compton of M.I.T. was asked, "Why is a chemical engineer in charge of the research laboratory of a company concerned with dairy products?" His two-fold answer suggests both a trend and a challenge. First, the prime qualification of a modern research director is that he be a team leader, that he have essential personal characteristics as well as broad technological background. Second, it was Dr. Compton's observation that the modern food industry is becoming more and more dependent upon the unit operations and processes of chemical engineering. Therefore it is to men with broad training in this field that management is now turning for executive leadership in research.

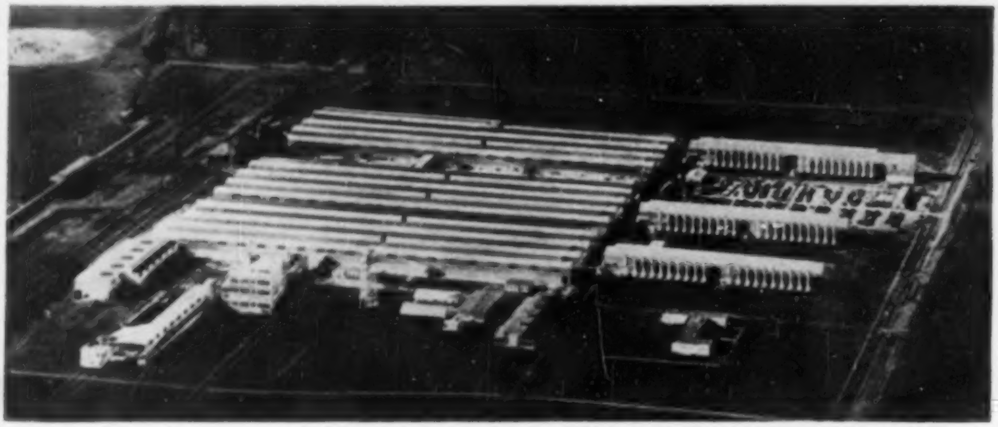
Louis Bromfield, the famous farmer-author of "Out of This Earth," was outspoken in his criticism of the tendency toward over-specialization, especially in the natural sciences. "In our times over-emphasis upon specialized research has led increasingly to the seeking of answers down certain narrow channels, while ignoring the countless variables and to the exclusion of the whole. All too often this over-specialization tends to lead into blind alleys and false assumptions—to produce laboratory and research technicians who are little more than glorified drug clerks." Harsh words, these, but they were tempered by an eloquent appeal for the Renaissance conception of the broadly educated man. "He is," said Bromfield, "the man who stands in awe of the universe and is constantly striving to penetrate deeper and deeper into a clear understanding of all the parts."

But it was Dr. Charles Glen King, scientific director of the Nutrition Foundation, who reminded us of milk and money. Return per acre in terms of food, agricultural economy and human health is greatest from the production of milk. It is our first line of defense in planning food supplies that will conserve the health of children and adults. It is a challenge to industry to use our technological resources to improve every process in its production and utilization.

Fairfield Osborn, president of the Conservation Foundation and author of "Our Plundered Planet," said that milk, with its 273 different nutritional factors, could aptly be called "the highest denominator of our foods." For too long we have neglected the so-called trace elements in our soils and the foods ultimately derived from them. Recent research has shown what appear to be parallels in plant and animal deficiency diseases, with certain pathological symptoms in man. The world's best factory for producing the anti-pernicious anemia vitamin, B-12, is in the rumen or first stomach of the cow. The spectrograph has shown us that B-12 contains an atom of cobalt, probably serving as a coordinating agent for the six complicated organic groups. This interested Mr. Osborn because 15 years ago someone had discovered that minute quantities of cobalt when applied to seemingly normal grass lands permitted the grazing of animals which otherwise would have fallen ill or died. Yet it was not until B-12 was crystallized that cobalt was recognized as one of man's essential trace elements. And it comes to our door every morning in a milk bottle!

These random notes reflect only a part of the stimulating discussion that made our day at Oakdale so pleasant and profitable. We congratulate President L. A. Van Bomel of the National Dariy Products Corporation for his vision and courage in purchasing the W. K. Vanderbilt estate and converting its luxurious facilities to a much more useful purpose. We congratulate President Lauren B. Hitchcock of the National Dairy Research Laboratories on the opportunity to apply his chemical engineering training and experience in the direction of research that can mean so much to mankind.

Sidney D. Kirkpatrick



In this aerial view of Alcoa's new reduction plant the three pot lines are at the left, the three powerhouses at the right.

Gas Makes Power for Aluminum

At its new Point Comfort works, Alcoa has 120 natural gas engines of novel design, each generating 1,000 kw. for aluminum reduction

Newest aluminum plant in the United States is the Point Comfort works of Aluminum Co. of America, situated on a 3,000-acre tract on Matagorda Bay near Port Lavaca, Tex. Although the reduction plant itself has many novel features, the one feature that is attracting the most attention is the 120,000-kw. generating plant that provides all the power needed to produce the plant's rated output of 114,000,000 lb. of aluminum per year. This plant is powered by two-cycle radial gas engines—of a brand-new type—120 of them, each rated at 1,600 hp.

These engines, built by Nordberg Mfg. Co. from designs developed jointly by Nordberg and Alcoa engineers, each have 11 cylinders of 14-in. bore and 16-in. stroke, arranged in a horizontal radial pattern about a single vertical crankshaft. Beneath the engine operating floor and directly coupled with each engine is its generator which produces 1,000 kw. d.c. at 667 volts, as well as 125 kva. a.c. at 425 volts and 25 cycles. The alternating current power is used for driving engine auxiliaries. Generators were supplied by three makers, Elliott, General Electric and Westinghouse.

There are 40 of these engines in each of three powerhouses which appear at the right in the view above. Each powerhouse serves one of the three pot lines, which occupy the lefthand portion of the air view. Engines operate at 360 rpm., achieving a thermal efficiency of 29-30 percent. Each consumes natural gas at a rate of 13,000 cu. ft. per hr. when under load, adding up to a gas load for the plant of over 30,000,000 cu. ft. per day. Total plant output is about 2,750,000 kwh. per day, with a consumption of about 10 kwh. per lb. of aluminum produced.

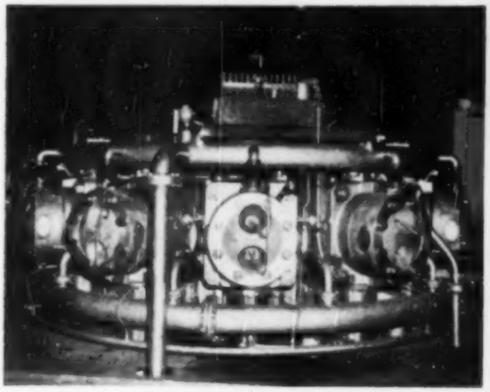
One earlier aluminum plant has previously been powered by internal combustion engines operating on natural gas, the Jones Mills, Ark., plant built during the war by Alcoa for the Defense Plant Corp., and now owned and operated by Reynolds Metals Co. That plant uses conventional engines, some of which operate on the diesel cycle, and some as spark ignition engines. The new Nordberg engine used at Point Comfort is designed to operate with slight modifications as either a dual-fuel, oil diesel or spark-ignition gas engine. In this particular installation the last named is the most economical arrangement. Except for the two plants mentioned, other aluminum reduction plants on this continent have all employed hydro power.

Engines are designed for easy accessibility of all parts for repairs. Circular manifolds for exhaust and scavenging air are situated on the lower floor, together with the truncated conical motor base that encloses the generator, and the motor-driven scavenging air blower. Intake and exhaust are timed by the pistons uncovering ports in the cylinder walls, so that the usual valves are not needed. Gas is admitted by cage-mounted gas valves operated by a cam on the crankshaft and located so that gas is admitted into the path of the scavenging air to insure thorough mixing. A governor controls gas admission according to the load.

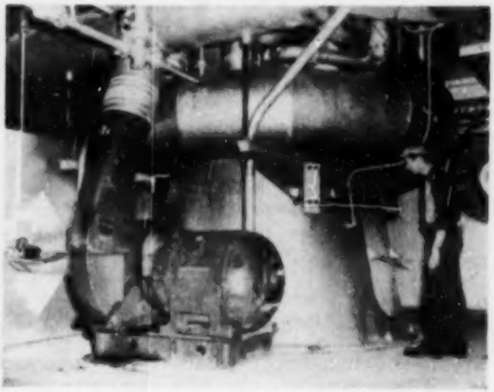
Each engine-generator unit has its own control panel but in addition, each of the 40-engine powerhouses has a master control room for indicating and recording the operation of each unit. Each engine has its own 100-hp. scavenging air blower and 7½-hp. generator cooling fan, as well as its own exhaust stack and dry-type air-blast cooler for engine cooling water and oil, and a combustion-air washer. Aluminum is used extensively for electrical conductors, heat exchange equipment, housings and building construction.

The company's gas supply is provided by a subsidiary pipeline company organized to gather the natural gas from both on- and off-shore wells and transmit it to the plant at pressures of 400-500 psig. Within the plant gas is distributed at 60 psig., entering the engines through regulators at 6 psig.

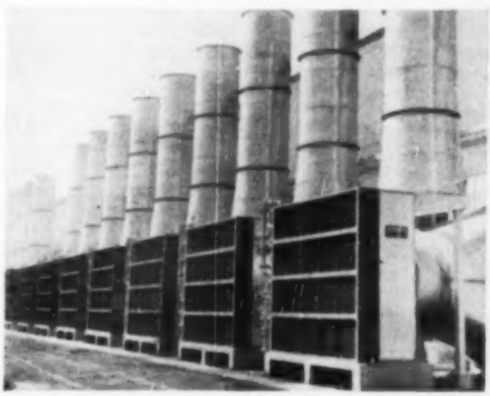
Operating floor in one of the three powerhouses, showing how the 40 radial engines and control panels are arranged. Engines each develop 1,000 hp. and drive a direct-connected generator which, with auxiliary equipment, is on the floor below.



Gas engines have 11 cylinders, 14-in. bore, 16-in. stroke. Governor, distributor, lubricator, gas valves are on top.

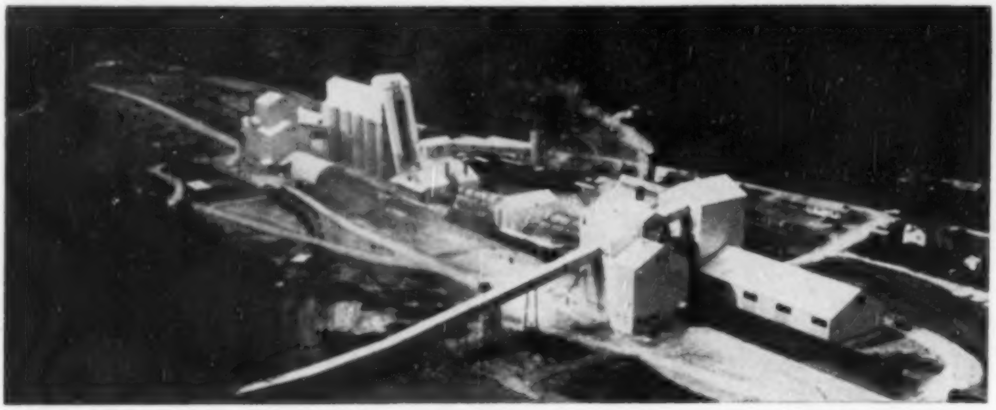


Engines are supported on a steel base housing the generator. Scavenging air blower and duct, exhaust manifold are shown.



Air-blast heat exchangers for cooling engine water and oil have 7-ft., 2½-hp. fans. Exhaust stacks are 7½ x 50 ft.

Actual control is from operating floor, but master control panels record operation of both engines and generators.



Rotary kilns like this, along with large vertical kilns, supply most of our lime needs. Kilns are located in 31 states.

Lime—An Industrial Chemical

Widely used in the process industries, its production has grown steadily. Today lime is our second largest chemical.

R. S. BOYNTON

If laymen and even some chemists and chemical engineers are asked today the question, "What is lime?", they will almost invariably reply that it is a "building material"—or "an ingredient of plaster"—or "the white stuff that farmers spread on their soil to grow healthier crops." Up until about 20 years ago such replies would have been substantially correct. But today lime as a basic (or industrial) chemical, enjoying the same heavy chemical status as sulphuric acid or soda ash.

This change in emphasis occurred first in 1929 when the total sales of "chemical" lime exceeded the combined building and agricultural sales for the first time. Since then, the increase in chemical sales has been steady. In 1948 (a big building year) chemical sales totaled 74 percent of all lime sold. In 1948, 4,255,403 tons of chemical lime were sold on the open market. However, it is estimated that another 2 million tons was actually consumed in 1948 as a chemical if the captive tonnages of alkali, sugar, carbide, metallurgical and other plants are included. Thus, as a chemical, lime ranks just behind sulphuric acid as the second largest chemical raw material utilized by industry, outstripping such well known basic chemicals as soda ash, caustic soda, chlorine, and alum in total consumption and shipments.

R. S. Boynton *is general manager of the National Lime Association, Washington, D. C.*

CHEMICAL MARKETS

The U. S. Bureau of Mines and the lime industry have always defined chemical lime on an end-use basis, namely consumption by manufacturing industries where this material almost invariably enters into one or more specific chemical reactions in the various stages of manufacture. These main industrial uses are:

Metallurgical—Although lime is used widely in many phases of the metallurgical field, its largest application is as a flux in purifying steel. Electric steel furnaces use lime exclusively instead of limestone to produce the special, high grade steels required for machine tools, and precision instruments. The basic open hearth also uses lime in addition to limestone, particularly in the final refining stages of the process which is known as "finishing the heat."

Several minor uses of lime in the iron and steel industry are in wire drawing, in "pig" casting and in neutralizing the acid residue after pickling steel.

In the far west lime is employed extensively in the flotation of copper, gold, and silver ores. It is commonly employed as a flux in the smelting of nickel and low carbon chrome and to absorb H_2S and SO_2 gases from copper and lead smelters.

During the first few years of World War II enormous quantities of high calcium lime were required in the manufacture of alumina via the Bayer process. Today some alumina plants are sintering largely with limestone instead of lime, but quicklime is required for desilification.

Most magnesia processes use large quantities of dolomitic lime. These processes include the Dow method from natural brines, dolomitic solvay process, and ferro-silicon. One other, the Dow seawater process, requires high calcium lime.

Pulp and Paper—Lime's function in pulp and paper manufacturing is multifarious. However, its largest application is probably as a causticizing agent in the sulphate and soda processes where the waste sodium carbonate solution is recovered and reacted with high calcium lime to generate caustic soda for reuse in the process ($Na_2CO_3 + CaO + H_2O = CaCO_3 +$

2NaOH). Most large soda and sulphate plants now recover 90-92 percent of the lime by drying the waste calcium carbonate mud, then pelletizing it before calcination in rotary kilns. The "make-up" lime required is purchased "fresh" from commercial lime plants.

In the preparation of the calcium bisulphite liquor required in the sulphate process some small plants still use dolomitic quicklime instead of limestone. Here milk-of-lime is reacted with sulphur dioxide forming a calcium magnesium bisulphite liquor, the key material used in the sulphite process. Manufacture of strawboard has always required large quantities of lime. The straw is digested to pulp by cooking it with milk-of-lime and steam in large rotary digesters. Most pulp plants prepare their own bleach liquor through the reaction of chlorine and milk-of-lime which produces calcium hypochlorite.

Sanitation—The largest use of lime in the sanitation field is for the purification and treatment of water in municipalities, industries, and railroads. The oldest method of softening water is the lime or lime-soda method. Here, lime is used to remove temporary hardness (magnesium and calcium bicarbonates) whereas the soda ash is required to remove the permanent hardness (sulphates). Turbid waters are generally treated with coagulants like alum or iron salts in combination with lime which serve to clarify these waters for potable purposes. Excess lime treatment has been employed successfully in purifying water in lieu of chlorine through maintaining a high pH. The aggressive carbon dioxide in corrosive waters is commonly neutralized with lime. Some plants will use lime primarily to precipitate iron, manganese, or fluorides from their water supplies. Quite recently dolomitic lime has found increased use in the removal of silica from boiler feed waters.

Municipal sewage plants commonly use lime for pH control in their sludge digesters, to neutralize acidic trade wastes which are collected in their system, and occasionally to precipitate suspended solids from effluents.

Industrial Trade Waste Treatment—The recent development and enforcement of federal, state, and municipal laws and regulations designed to arrest stream pollution by industries has focused attention on lime as a means of chemical treatment. Many plants will have to resort to lime for chemical neutralization and precipitation.

Chemical Manufacture—Largest use for lime in the manufacture of chemicals is in the alkali industry where a high calcium line is an essential material in the ammonia soda process for the manufacture of soda ash and caustic soda. There are no lime shipments to this industry except in possible emergencies since without exception all alkali plants burn their own lime. The economics of the Solvay Process depends on cheap CO_2 which is required in the process. As a result, in burning their own lime the alkali plants recover the CO_2 as a coproduct with lime.

The biggest shipments of lime to the chemical industry are for the manufacture of calcium carbide. High calcium lime and coke are fused together at high temperatures in an electric furnace ($CaO + 3C = CaC_2 + CO$) with calcium carbide, the country's chief source of acetylene, resulting. It requires approximately one ton of lime to produce a ton of calcium carbide.

Lime is also required in the manufacture of many other industrial and fine chemicals and pharmaceuticals. Magnesium oxide and hydroxide are produced from lime by several different processes; high calcium lime is required in the manufacture of calcium phosphates (mono, di, and tri), chrome chemicals, citric acid, calcium cyanamid and cyanide, the recovery of ammonia from coke-oven areas, acetate of lime, chloride of lime; precipitated calcium carbonate and high test calcium hypochlorites and ethylene glycol.

Glass—Of all the raw materials entering into glass, lime and limestone rank third. A common glass batch is composed of 70 parts sand, 18 parts soda ash, and 12 parts lime, this will vary for different types of glass. Some glass plants prefer to use limestone and others lime. On an equivalent CaO basis the relative consumption of lime and limestone appear to be about the same.

Insecticides—Lime has long been used as an ingredient in agricultural insecticides and sprays. It reacts with arsenic acid to form calcium arsenate and generally additional free hydrated lime is added as a carrier for dusting crops. It is commonly employed as a carrier (or diluent) with Bordeaux mixture, lead arsenate, Paris green, and other insecticides.

Lime-sulphur sprays (calcium polysulphides) are made by heating sulphur and milk-of-lime. Lime also is mixed with sulphur in a dry state and is used for dusting crops as a fungicide.

Leather Tanning—Tanneries have always employed a lime suspension for plamping and dehairing hides. As a depilatory, lime is often used with small amounts of "sharpening" agents like sodium sulphide or arsenic sulphide.

Other Uses—The number of uses of chemical lime are legion. Some of the relatively minor uses of this product are in the manufacture of sand-lime brick where 5-8 percent high calcium hydrated lime and the remainder fine grained sand are autoclaved with steam under pressure to form a true, stable monocalcium silicate. Insulation materials are also made with lime and diatomaceous earth. Lime is used extensively in both cane and beet sugar. However most sugar mills produce their own lime as they also require low cost CO_2 in the process.

It is used in the manufacture of cement and cold water paints and varnish; in silica bricks (refractory); lubricating grease; causticizing in soap plants; conditioning drilling muds in oil well drilling; in petroleum refining; manufacture of satin white, iron oxide, and antimony oxide pigments; animal glue and gelatin; utility gas purification; and numerous other special uses.

TYPES OF CHEMICAL LIMES

Just as sulphuric acid has always been the lowest cost acid available so is lime the lowest cost alkali. Chemists and chemical engineers are recognizing this fact more and more in using lime for pH control in an increasing number of applications. Another factor covering growth of chemical lime is that the quality and uniformity of lime have steadily improved.

Today, many chemists are employed by the industry and chemical control has become an important consideration in lime burning. Well equipped and staffed laboratories, are not uncommon today. But 40 years ago they were unknown. In addition, many rotary and vertical kilns are now operated largely or entirely by chemical control instruments. Lime plants are selecting their limestone and stone deposits with greater care. As a result limes of higher available CaO or combined $CaO + MgO$ content with greater reactivity and uniformity are now produced.

The two industry products are quicklime (CaO) and hydrated lime ($Ca(OH)_2$). The quicklime is sold as lump lime (from vertical kilns) of 8-in. to 6-in. top size; as pebble lime in various sizes ranging from 1½ in. to ¼ in., and as pulverized or powdered quicklime. It is shipped in bulk, preferably in hopper bottom cars and in bags. Hydrate is commercially produced as a free flowing, extremely

fine white powder. For all practical purposes most hydrates are completely hydrated and through air separation and milling virtually all calcium carbonate core and coarse particles are removed. The usual degree of fineness is about 96 percent passing a 325-mesh sieve. However, by adjusting the hydration process it is possible to produce hydrate of even smaller particle size. Lime particles have been measured as small as 0.20 micron. Some plants are equipped to ship hydrate in bulk, but most shipments are made in bags because of the greater ease in handling and storing.

Basically there are three different types of lime: (1) high calcium where the MgO content does not exceed 3 percent (this is a liberal definition since the MgO of most high calcium limes today will not exceed 1 percent); (2) magnesium lime where the MgO content ranges between 5-15 percent; (3) dolomitic lime where the MgO content ranges between 30-40 percent (a true dolomitic lime is generally considered to have about a 60 to 40 ratio of calcium and magnesium oxide). Type (2) has virtually disappeared in this country since it contains too much MgO to be of value in many of the chemical markets, and lacks sufficient MgO to qualify as a good dolomitic building lime.

Generally high calcium lime is preferred. It is more widely used in most chemical fields. Dolomitic lime occupies a similar role of superiority in the building field. Nevertheless, there is a definite preference for dolomitic lime in a number of industries, such as in glass, sulphite pulp plants, magnesia products, and silica removal from boiler feed waters. Many users of agricultural "spray" hydrated (insecticides) prefer dolomitic. However, recently with general interest centered on lime as a neutralizing agent in the treatment of acidic wastes, dolomitic lime has developed increased interest as a chemical lime in view of its greater basicity than high calcium lime. From a neutralizing standpoint, 100 tons of dolomitic quicklime and hydrate are equivalent to 118 and 129 tons respectively of high calcium quicklime and hydrate. Because of this superiority in basicity and the fact that the resulting sludge volume is smaller, several large chemical process plants have selected dolomitic over high calcium lime in spite of its obvious disadvantage of slower reactivity and filterability. This does not mean that high calcium is "out of the picture," but simply that both limes have a definite place in neutralization. The final determination will vary from plant to plant. This discussion on dolomitic lime is simply to correct the fallacious thinking of some technical men that all dolomitic limes are impure and that MgO is a poison in all chemical processes. Actually some dolomitic limes from northwest Ohio in particular are as pure chemically as the best high calcium limes from the standpoint of silica, alumina, and R_2O_3 content.

Many chemical process industries have their own complete or partial specifications on lime. ASTM Committee C-7 on Lime has written specifications for many chemical uses of lime as well as methods of chemical analyses in determining available CaO, total oxides, and the various impurities.

RESEARCH

Some lime companies have carried on research designed to improve their own products and plant efficiencies, but the commercial lime plants have done very little on fundamental research or research for new chemical markets. For industry-wide research of this kind the commercial lime plants today are depending largely on the National Lime Association, which has been concentrating its activities on fundamental and applied research for the past four years.

One long range association program is a fundamental study of lime at M.I.T. Particle size, surface area, and porosity determinations have been made. Currently a wide range of different kiln feed (limestones) is being calcined in a laboratory rotary kiln. Through use of the differential thermal analyzer studies are being made on how the impurities, calcining temperatures and lengths of burning time affect the final physical and chemical characteristics of the lime. Results of these tests are being compared with similar tests on lime made experimentally from pure calcite. This research may eventually answer the question of why two limestones of almost identical physical and chemical properties should possess such entirely different rates of reactivity and settling qualities when calcined and subsequently hydrated.

In applied research the National Lime Association is sponsoring research at Rutgers on sewage and trade waste treatment. Research on pickle liquor and canning wastes have been completed recently. Currently fundamental research on lime neutralization of various types of acid wastes is being conducted.

The association is carrying on research at Purdue University on a new, promising non-chemical use of lime in road stabilization. Small percentages of lime when mixed with certain plastic clay soils and base course materials have developed unusual strength and stability on roads in Texas through what is believed largely pozzolanic action. It is expected that this study will soon reveal lime's place in this field.

MARKET DEVELOPMENT

Traditionally the lime industry has been conservative and unaggressive; its interest has been more on production than sales. It has relied on the low cost and all-round versatility of its products to develop the many new chemical markets that have materialized in the past 20 years. Promotional and development work by the lime companies themselves has not been particularly active and selling has largely been on a commodity basis. Lately a few companies have embarked on a creative sales program in the industrial waste field. Pilot plants have been built by the Marblehead Lime Co., Chicago, and Warner Co., Philadelphia, enabling these companies to perform considerable development research on lime neutralization in this new chemical field, and at the same time supply valuable technical assistance to actual and prospective customers. However, for the most part virtually the only industry-wide development work has been a modest amount performed again by the National Lime Association. Besides conducting research the Association publishes promotional and technical bulletins which are distributed widely.

LIME PRODUCERS

Originally, most lime plants were small, family-owned manufacturing companies. Even today there are many such family-owned companies which have been handed down from father to son for generations. However, a number of these companies have grown considerably in the past generation. An example is Mississippi Lime Co. of Ste. Genevieve, Mo., which operated about 15 to 20 low capacity vertical kilns in 1930. Now this company also operates seven large capacity rotary kilns plus two other good sized vertical kiln plants which they recently acquired. However, even the biggest commercial lime plants will only compare in size to the smaller chemical manufacturers. This can be readily appreciated when the total annual lime sales for the industry amount to only $58,000,000.

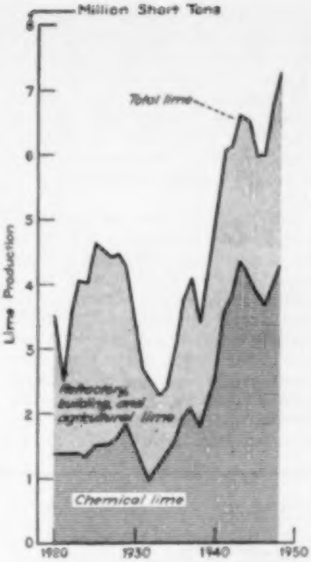
In 1909 there were over 1,000 in-

dependent lime plants. Today the National Lime Association estimates that there are only 118 of commercial significance. However, including all burned lime sales the 118 plants today produce about 110 percent more lime than in 1909. This indicates that while lime plants have dwindled in number, their average size has simultaneously increased at even a greater rate.

The principal reason for this drastic reduction of lime plants is not due to absorption by large holding companies. It is due to the fact that the business has become predicated on a very small margin of profit as a result of highly competitive conditions over the years, and volume is essential in most cases for a profitable operation. The exceptions to this premise are largely cases of small lime plants that are located in isolated sections of the country with the protection afforded by freight rates and sparse markets. The low average profits existing in the industry and the high fatality rate of small lime plants have discouraged new risk capital in recent years. As late as 1925 a person could enter the business on a modest investment of $20,000. Now at least $500,000 would be required and many lime manufacturers consider the minimum investment necessary to be at least $1,000,000. Added to this is the fact that since the demise of the OPA, lime prices have only advanced on an average of about 30 percent while construction costs have risen 75 to 125 percent. The cost of plant amortization, as a result, to most investors appears insurmountable. Naturally, the steady increasing labor costs since 1945 have worked more to the detriment of the small vertical kiln plants than to the more mechanized rotary and large capacity vertical kiln plants. In the past year, two well-established vertical kiln lime plants have abandoned the business permanently because of lack of profit.

CAPTIVE PRODUCTION

There is probably no chemical, excepting only sulphuric acid, which has quite as much captive production as the lime industry. A large amount of this production emanates from the alkali and sugar industries which is understandable since the economics of their processes are predicated on inexpensive CO_2, the coproduct of lime manufacture. The other captive producers are scattered. They include such companies as Union Carbon and Carbide, Sheffield, Jones & Laughlin and Bethlehem Steel, Johns-Manville Co., Dow Chemical Co., Aluminum



Corp. of America, to a limited extent International Paper Co., and most lately the Southern Cement Co. All of these companies are enormous consumers of lime. Many of these concerns do not produce all of their own requirements and are forced to purchase open-market lime as well. The principal reason for this captive production is largely due to fear that their total requirements cannot be filled by the lime industry. A few were not satisfied with the quality of the commercial lime available. In one case it was due to idle kiln capacity in their plant. However, captive lime production has not always been successful. In recent years, two producers discontinued manufacture in favor of open-market lime. The correlation in locating deposits of suitable limestone with the burning plant and consuming points is becoming more and more difficult because of the growing scarcity of quality stone and increasing freight rates. Even for those large corporations that prefer integrated operations, it does not offer an attractive investment at present production costs and prices.

WIDESPREAD PRODUCTION

Lime is being produced in 31 of the 48 states. While the increases in freight rates have added to its net cost, they have not affected its consumption as a whole since the freight costs of other competitive alkalis have increased similarly. A factor in the growth of lime as a chemical has undoubtedly been due to its plentiful supply (except for wars) and widespread availability.

Most lime companies quarry their own stone; however, a few successful plants that are situated on the Great Lakes have purchased their stone from the largest limestone quarrying operation in the world, the plant of Michigan Limestone and Chemical Co. at Calcite, Mich., and to a lesser extent from the Inland Lime and Stone Co. in the Upper Peninsula of Michigan. Here limestone is shipped in bulk by water similar to iron ore. Shipment by rail would make the cost prohibitive.

Although most of the companies obtain their stone from open quarries, there are a number of plants that mine their stone, notably in the Bellefonte, Pa., and Ste. Genevieve, Mo., districts. At Bellefonte, the stope method of mining at different levels is employed down to about 800 ft. in contrast with Ste. Genevieve where mining is done on one level at less depth. The deepest mine is about 2,250 ft. and is operated by a captive plant, the Pittsburgh Plate Glass Co. (Columbia Chemicals Div.) at Barberton, Ohio.

Two trends in extracting limestone have improved the quality of lime and lowered production costs. They are: (1) Use of trucks in hauling stone from the quarry to the primary crusher and (2) more extensive use of stone classifying equipment which enables a manufacturer to screen his stone more carefully so that in one rotary kiln he may burn for example, 1-in. stone and in another kiln ½-in. stone. This uniformity in size gives more uniform lime. In view of the many different ways of obtaining stone, the cost of kiln feed stone varies greatly.

LIME BURNING PLANTS

There are many different types of kilns in operation today. The old fashioned pot kilns and mixed feed kilns are still in existence, but are generally regarded as passé though a few plants are still able to operate them profitably. With the emphasis on greater capacity more interest has been focused on large capacity rotary and vertical kilns. Many plants formerly operating standard-low capacity vertical kilns of 10 tons capacity per day have converted these same kilns into much greater capacity kilns of 25 to 50 tons per day at considerable investment. Most of these conversions are called the "Azbe gas-fired kiln," and they have been successful in reducing costs.

Since the war, two new types of kilns have appeared. One is the Fluo-Solids kiln which the New England Lime Co. operates successfully at Adams, Mass.; the other is the Ellernan kiln, which is being operated successfully at several plants on a small scale. The Fluo-Solids kiln is based on fluidization (see *Chemical Engineering* Dec. 1947, p.112) and is featured by its extremely low fuel ratio and high capacity but its use is largely limited to certain types of soft limestone. The Ellernan kiln is featured by its ability to burn small stone low capacity producing units of about 12 tons per day, and the use of oil or gas as fuel.

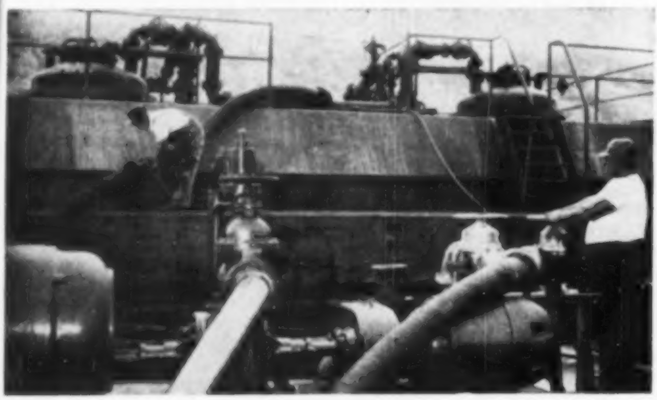
Naturally, the largest capacity kiln is the rotary, but also requires the greatest investment. Some rotary kilns are known to produce as much as 300 tons per day. Because of the mechanized nature of the operation, large rotary plants can operate at the lowest unit labor cost. However, their fuel costs are higher than efficient vertical kilns. Rotary kilns of over 400 ft. in length are currently in operation. The diameter of most recent kilns ranges between 8 ft to 12 ft.

Coal and wood, the two traditional fuels for lime burning, have been replaced to a large extent by oil and natural gas. In the far west, oil is used exclusively while natural gas has been largely utilized in the south, southwest, and Mississippi valley section of the middle west. Many lime plants in the east and middle west operate producer gas plants. The chronic, unsettled coal supply situation has been a major problem for those plants using coal in recent years with considerable production losses resulting.

Chemical Lime Shipments
1948

Use*	Net Tons
Steel (flux)	1,131,098
Pulp and paper	697,884
Calcium carbide and cyanamide	569,642
Water purification	475,287
Glass	235,866
Non-ferrous metallurgy	211,134
Sewage and wastes treatment	101,917
Insecticides and fungicides	92,037
Leather tanning	88,329
Petroleum refining	57,434
Sand-lime and silica brick	38,333
Coke and gas purification	29,972
Stock feed	26,353
Sugar refining	24,510
Calcium carbonate (precip.)	20,318
Gelatin and glue	19,429
Wire drawing	18,585
Paints and varnish	14,073
Undistributed	164,187
Unspecified	238,514
TOTAL	4,255,403

* Excludes captive use.



To Dow, barges mean cheap transportation, opening of far-away markets.

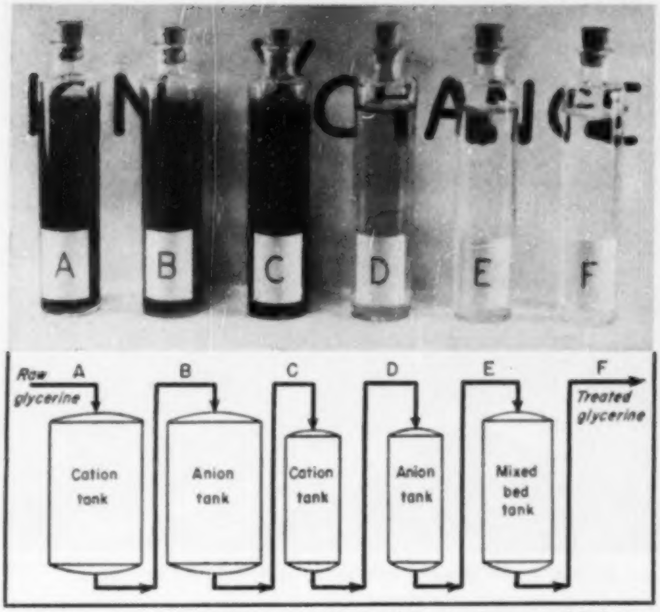
How to Move Muriatic by Barge

Handling and transporting large quantities of hydrochloric acid is a tricky business. In recent months considerable information has been given concerning the method of shipping bulk hydrochloric acid by barge. Since late in 1947 Dow has been using large quantities of the acid from Freeport, Tex., to Cincinnati, Ohio.

Now details of their operation can be made public. Dow is now operating a fleet of nine barges which can transport about 3½ million gallons per year of hydrochloric acid from Freeport to Cincinnati. The fleet consists of four hopper-type cargo barges fitted with rubber-lined tanks, plus five new barges designed by Dow engineers in collaboration with naval architects of Dravo Corp., Pittsburgh. Each of the new 195-ft. barges is equipped with four tanks—each tank has a 12-ft. diameter and is 73 ft. long. These are the largest rubber-lined tanks ever fabricated for use on a barge. For better efficiency domes of the tanks are located in a central point in the barge and protrude through a working platform that is sloped outboard to provide drainage for spilled acids. Dow loads its barges from a dock that carries a 6-in. rubber-lined steel pipe extending to the storage tanks. To this pipe is attached a small 4-in. flexible acid-resistant Saran hose. The 4-in. line is connected to the 6-in. common header pipe on the barge during loading the flow into the individual tank is controlled by valves within the barge. A two-man crew loads the barge in about 8 hours with 233,600 gal. (about 1,000 tons) of 22 Be acid. After the barge has been loaded a specification analysis is made. Another is made in Cincinnati.

Dow's small tug, Edco, tows the barges from Freeport to Galveston where a contract carrier picks them up for a trip through the Inter-coastal waterway to the Mississippi river. There another barge line takes them to Cincinnati. Unloading procedure requires the use of a special 4-in. valve centrifugal acid pump. After the pump is started air is forced into the pump with the excess pressure vent to help suction. Air is shut off when full suction has been obtained. There is a sump at the bottom of each tank permitting the tank to be stripped of a batch of cargo. The Cincinnati terminal has a 4½ million gallon storage capacity tank.

An average time of 60 days is required for the 3,500-mile round trip. This includes delays in unloading the barges. In addition to the savings resulting from economical river shipping rates, Dow's traffic department explains that a substantial amount of time has been saved loading the barges. It takes 22 hours to load tank cars of the same quantity of acid that can be loaded into a barge in eight hours. Moreover in loading tank cars with the acid, pipeline connections have to be made for every 8,000-gal. car, while only one connection is required to load 233,600 gal. into one barge. This cuts down the number of chances for spilling and saves wear and tear on equipment.



A three-stage ion exchange unit of two cation-anion stages and one mixed bed stage (as in diagram) reduced the color of crude glycerine from opaque to water-white as shown by reference letters on samples and at corresponding points on flow diagram.

Purifying Crude Glycerine By Ion Exchange

Ion exchange can eliminate distillation, although not evaporation, in the purification of crude glycerine. In many cases it is also cheaper

F. H. KAHLER

Ion exchange has made an important place for itself in the removal of dissolved, ionizable solids from water. Now it is also going into a variety of purification operations on materials other than water. One of these, now being installed by three glycerine producers, is the removal of ionized solids (ash), color- and odor-producing materials from dilute aqueous glycerine solutions.

Ion exchange for purifying glycerine solutions has several advantages compared with earlier methods: (1) It gives a more uniform product, all of C.P. quality, and at lower operating cost in most cases; (2) its product is more stable to light; (3) no foots are produced, since the purified solution can be concentrated without loss. The new process offers the further advantage for new construction of lower capital investment. As an addition to present capacity it means a better product of greater uniformity and higher quality.

In removing ionizable materials from aqueous solutions of non-ionized material such as glycerine, the solution is passed in series through a cation exchanger and an anion exchanger, or through a mixed bed of cation and anion exchanger, or through a combination of these. Early passage through a single pair of cation exchanger and anion exchanger beds removes 90 percent or more of the ionizable materials in the solution. Thus the first passage will leave 10 percent or less, while the second passage will leave 1 percent or less of the original ionizable material present in the untreated solution. How much ionizable material is initially present, and what concentration can be tolerated in the final solution, determines whether a single pass is enough, or whether a second or perhaps a third pass will be needed. Often additional color-removing material is used also.

Ion exchange has been successful in purifying a wide variety of glycerine-bearing solutions, ranging from waste sweetwater with 3-5 percent glycerine, through normal sweetwaters with 8-15 percent, to saponification crudes and soap lye crudes in which the ash content runs as high as 15 percent. With ion exchange, any of these materials will produce a dilute glycerine which can be concentrated to a C.P. product without distillation. The diagram presented here shows a simplified schematic flowsheet of a three-pass unit for treating crude glycerine. It consists of two cation-anion passes and a mixed bed unit. The reference letters refer to the sample bottles above and show the appearance of the glycerine at each stage.

Operating costs for ion exchange treatment include regenerant chemicals—sulphuric acid and caustic soda—as well as resin and equipment amortization, labor and evaporation (crudes must be diluted before ion exchange). Cost of regenerant chemicals is directly proportional to the ionized solids content of the raw material. Cost per pound of glycerine consequently depends on both the ash content and the glycerine content of the raw material. Regenerant chemicals for treating a sweetwater with 10 percent glycerine by weight, containing 0.5 percent ionizable solids, cost about 0.25 cents per pound of 95 percent glycerine produced. Resin and equipment amortization depend on the type of material being treated, while labor and evaporation costs depend on fuel supply and other local conditions. In general, however, ion exchange is cheaper than distillation for crudes with less than 10 percent of ionized solids, and for sweetwaters with less than 2 percent of ionized materials.

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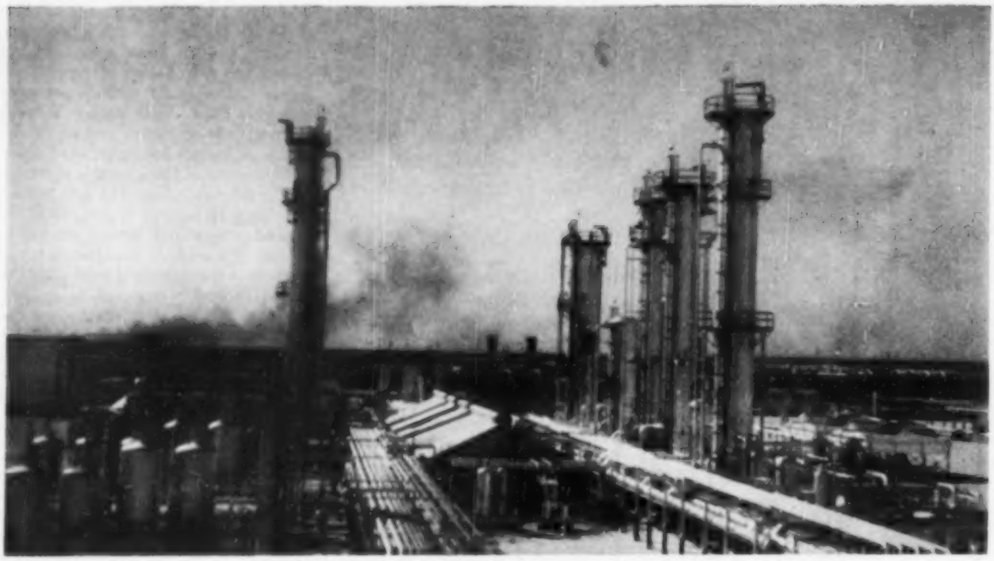

Sid Richardson's new natural gasoline unit gets big yields of pure hydrocarbons by processing West Texas natural gas.

Hydrocarbons from Natural Gas

Proper processing of pipeline gas shows novel chemical engineering methods and produces valuable raw materials for chemical manufacture.

H. H. JONES and JOHN T. COX, Jr.

FOLDOUT FLOWSHEET
To follow this natural gasoline process more easily, unfold the special Pictured Flowsheet on page 178. You may want to keep it before you as you read.

Much has been written about the great chemical frontier of the Southwest and the emphasis has been laid on the Gulf Coast of the area. However, Texas is a very large State and has within its confines other great resources in addition to those found on the Coast. The West Texas area running up to the New Mexico border has such tremendous oil and gas reserves that it staggers the imagination of even hardened Texans. The latest discovery, the Scurry County Reef, has a potential even greater than that awesome flood of petroleum of 1930's East Texas.

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West Texas gas fields will supply the major part of the demand of the California pipelines and the anticipated completion of construction of these great lines is in sight. They will take several hundred million cubic feet a day and the gas has to be carefully prepared for the 1,500 mile transmission to California. Hydrocarbons and sulphur compounds being extracted, or available for extraction, from these large volumes of gas total many tons per day of potential chemical feed stock.

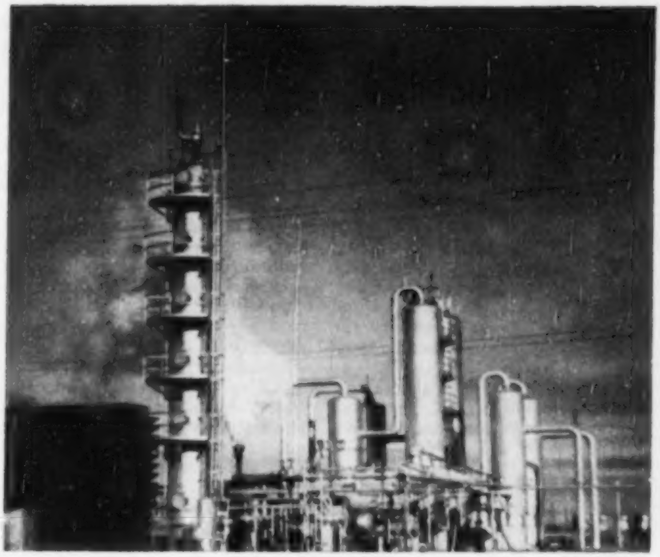
A 50 YEAR SUPPLY

Gas comes from the underground reservoirs in these areas containing much ethane, saturated with propane, butanes, and pentanes. New reservoirs are being discovered every day, and presently producing fields are conservatively calculated to be productive from 30 to 50 years. A typical analysis is:

	Mol %
Methane	81.98
Ethane	9.51
Propane	4.52
Butanes	1.92
Pentanes and above	1.45
CO_2	0.36
H_2S	0.26
	100.00

It is necessary from both economic and operational viewpoints to remove the heavier hydrocarbons from the gas, as well as to have it "sweetened" by H_2S removal before it enters the pipelines. This brings into the picture the natural gasoline plant, one that to the chemical engineer is essentially a chemical raw-material producer.

The classical natural gasoline or "distillate" plant has been known for many years. In it raw gas is bubbled through a light petroleum oil which absorbs the higher-homolog constituents and then the oil is stripped of this burden, to be recirculated to the absorber tower. The products of such separation are the basis for both light



Stripped gas goes to customer who removes H_2S and water, pumps it to pipeline.

fractions for natural gasoline blending, and a huge bottled-gas industry for industrial and domestic heating in the form of LPG (liquefied petroleum gas). These older-type plants dot the countryside in Texas where they have contributed very largely to the elimination of the wasteful flaring of the residual gas of the oil fields.

Many of the older plants besides producing natural gasoline for motor fuel blending, also make a mixture of hydrocarbons that easily meets the requirements of the LPG industry. The chemical industry requirements, however, require sharper fractionation of individual hydrocarbon compounds for higher purity. Newer plant designs are accomplishing this and are also recovering higher percentages of the total hydrocarbon originally present in gas. This makes for a better overall economy and gives opportunity for the chemical industry by producing large quantities of almost pure hydrocarbons. Recently, large quantities of hydrogen sulphide have appeared as a byproduct chemical, and one from which sulphur may be extracted for acid manufacture or other sulphur compounds. This sulphur is competitive with naturally mined sulphur. An outstanding example of the new type "gasoline" plant processing gas is that of Sid Richardson Gasoline Co. near Kermit, Tex.

This new Sid Richardson gasoline plant has been designed for a 75 percent recovery of propane and a 98 percent recovery of butane and heavier homologs from the field gas. At appropriate points in the system, ethane-rich fractions also are available for further processing. Pentanes and other light gasoline fractions are also separated, ready for further purification as needed. This Kermit plant contains several engineering features that are of great significance for chemical engineers both inside and outside the petroleum industry.

On first inspection the beauty of the plant is apparent. The symmetry of lay-out has been planned to enhance safe, efficient operation. The striking first impression is acentuated by the extensive use of polished corrugated aluminum sheet for tower and pipe covering. Beauty gained is a by-product of practical considerations. The life of this type of covering seems perpetual; and the surface maintenance costs for equipment so covered are practically zero.

KEYSTONE SUPPLIES FEED

This plant receives gas of the typical analysis from the Keystone field which gas is produced from seven underground reservoirs at different depths. Some of the gas comes into the plant at 600 psi., but a larger quantity comes in at lower pressure, some at only 1 psi. This low-pressure gas is first compressed in three stages to 600 psi. to join the stream of high-pressure field gas entering the base of the absorbers. As the present time

Plant Highlights

1 Care in design has achieved a flexible and balanced operation. This enables the plant to automatically float on the gas lines with a variable volume of gas supply without appreciable loss of efficiency. This is particularly useful in this area, since allowable petroleum production is varied from month to month by State regulatory authorities. If the allowable petroleum production goes down, the gas volume is affected in the same manner. But this plant operates efficiently even under such a wide variety of conditions.

2 With an eye to future use of its products by the chemical industry, this plant has been designed to give very accurate cuts of the high homologs and the natural-gasoline fractions. This is being achieved through very exact temperature and pressure control in the fractionation sections.

3 Exact balance of utility requirements and complete independence as far as electric power, makeup water, steam and fuel gas is concerned.

4 Unusually complete automatic control of a continuous unit brings manpower requirements to a very low level. This large plant has an operating staff of about 50, which includes three shifts of operators, all administrative, technical, and maintenance personnel.

5 Application of the divided compartmental plate technique for heat extraction or heat addition gives, in effect, multicolumn performance in one vessel.

6 Pure propane is the refrigeration medium in the refrigeration cycle. Propane is almost as efficient as ammonia thermodynamically and is much cheaper for initial charge and makeup.

7 Safety for operating personnel and protection of equipment is carefully considered in each design and construction step. Besides conventional fire-fighting equipment, many proven appliances are installed to automatically shut down equipment in cases of over-pressure or excessive temperature.

8 Attractive design has been achieved with no sacrifice of engineering efficiency. Using the most modern type of heat insulation covering, the designers have combined utility and beauty. This design represents good publicity.

there are 40,000,000 Standard Cubic Feet of low-pressure gas and 15,000,000 of high-pressure gas being processed daily.

The absorber towers are 70 ft. high, containing 22 trays designed to operate at 600 psi. Absorber oil is delivered to the towers by four 330 gpm. centrifugal pumps driven by 250 h.p. steam turbines. The oil enters the tower on the top tray and is partially cooled across two trays by the rising gas leaving the top of the absorber. This oil then drops to a tray of two compartments run in series. There the oil is taken from the first compartment at 90 deg. F. through a chiller (refrigerated by propane) and then returned to the other compartment at 50 deg. F. This cooling process is repeated in the same manner on the eighth tray. Each of the two towers thus has two intertray chillers that use a total of 300 h.p. for propane compression to provide refrigeration. This two-stage refrigeration of the absorber oil results in extremely efficient stripping of the gas, so that the plant has exceeded design capacity in both throughput and recovery.

PASS GAS TO PIPELINE

The stripped gas from the top of the absorber towers is delivered to the pipeline customer. He removes the hydrogen sulfide by typical diethanolamine treatment. The gas is also dehydrated with diethylene glycol and is then pumped into the long distance transmission lines.

The rich oil that comes from the bottom of the absorbers is at about 80 deg. F. and under a pressure of nearly 600 psi. It contains besides the desirable hydrocarbon product gasolines, a large amount of methane. As this pressure is reduced to 385 psi. in the "fat-oil" flash tank, a large part of this dissolved methane comes out of solution and is compressed back into the pipeline supply.

Since it is desirable to eliminate ethane also at this point, the oil is passed from the flash tank through a 27-plate reabsorber column, operating at about 200 psi., with a bottom temperature of 100 deg. F. To speed ethane elimination, the oil is taken from the eleventh tray in this column and is bypassed through an external reboiler. The fat-oil at the bottom outlet of the tower is said to be "stabilized" and is ready for the true stripping still. This reabsorber also receives recycle vapor streams into the bottom, and during the passage of these vapors upward, recovers desirable constituents of propane and heavier.

The stripping still is a 10 by 62-ft. cylindrical vessel with 20 trays. It is fed at the twelfth tray with the fat-oil, the temperature of which has been raised to 350 deg. F. by a heat exchange previous to entering the tower. The fat-oil is joined at this point with an additional stream of pre-heated hydrocarbons that have accumulated in the separaters or knock-out drums during the initial compression. It is to be noted that this additional stream also has gone through successive stages of decompression to eliminate methane and ethane; and it enters the tower at the prescribed 200 psi. set by the main stream of fat-oil.

Entering the twelfth tray at a temperature of 350 deg. F., the major part of the fat-oil's hydrocarbon burden flashes off and dephlegmates up through eight trays to the overhead. The partially stripped oil drops down the tower onto the tenth tray. This is divided into two compartments: from the first, the oil is bypassed through a gas-fired rich-oil tubular heating furnace, and then returned to the companion compartment at the elevated temperature of 500 deg. F. Turbine exhaust steam is fed into the bottom of the still and during its ascent helps strip the gasolines from the descending absorber oil in the still.

As the stripped oil leaves the base of the tower, the sensible heat is recovered by incoming tower streams so that the lean oil cools to 145 deg. F. before it is cooled by water sprayed coils to 90 deg. F. This cooled oil is the lean oil oil pumped into the absorbers. The overhead vapors and stripping steam from the still passes first through air-cooled finned tube coolers, then through separate water sprayed cooling coils and then to propane refrigerated condensers, leaving finally at 50 deg. F. and 100 psig. Reflux is taken intermediately from this stream to provide the proper ratio for tower equilibrium. Any uncondensed vapors from the propane refrigerated condenser are recompressed and returned to the 200 psi. primary column for re-absorption of the desirable hydrocarbon components with the unwanted methane and ethane going overhead for recycle to the absorber and hence to the pipeline.

FRACTIONATE THE OVERHEAD

The total liquid hydrocarbon (overhead) product from the stripping still is now ready for fractionation. It contains small residual amounts of methane and ethane and these are removed in a conventional de-ethanizer column, the overhead vapor of which contains about 71 percent methane and ethane and 29 percent propane. These vapors are refrigerated to 70 deg. F. which liquefies much of the propane at this pressure to provide reflux for the tower. Bottoms from the de-ethanizer pass to a de-butanizer column, the overhead of which is a mixture of propane and butane. The bottom is normal natural gasoline, containing the pentanes and heavier hydrocarbons. The de-butanizer overhead passes to the de-propanizer column where propane is taken off overhead and the bottoms may be taken off either as butane or lpg mixture, determine by market demand.

All of the liquid products are treated for complete hydrogen sulphide removal and partial mercaptan removal by caustic washing and then they are given a further treatment with cuprous chloride for mercaptan and thiophene conversion to disulphides, which are non-corrosive. This plant also has a complete unit for the regeneration of caustic to remove and recover mercaptans absorbed therein.

KEEP WATER DOWN

Water consumption is held to a relatively small volume by the use of air-cooled, finned-tube condensers wherever stream temperatures are high enough to make their use practical. All of the compressor engine jacket water is cooled in this manner, and the still overhead gasoline vapors are pre-cooled before entering the refrigerating condensers. Fresh makeup water supplied by the plant's own 280-ft. deep water wells is treated under rigorous chemical control.

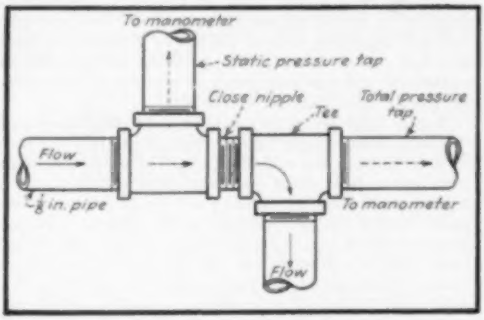
Steam at 400 psig. and 675 deg. F. is provided by two watertube boilers each of 42,000 lb. capacity per hour, one boiler being a standby unit. The steam demand is so well balanced that no excess exhaust has to be condensed. All large pumps are turbine driven and exhaust is used for process steam in various parts of the plant for reboiling, stripping, etc.

Gas compression, vapor recompression and propane refrigeration uses a total of 15,600 horsepower supplied by 13—1,200 horsepower right angle, direct connected, two-cycle gas burning engines. The plant makes is own electricity with four 300 kw., 60 cycle, 440 v. generators driven by four-cycle gas burning engines.

This plant is typical of the high grade of chemical engineering that should now go into natural-gasoline plants today. It also demonstrates some new features of technology that chemical engineers from other industries can well afford to study.

The Plant Notebook

THEODORE R. OLIVE, Senior Associate Editor



How to Measure Flow by Impact With Ordinary Pipe Fittings

MELVIN NORD, *Associate Professor of Chemical Engineering, Wayne University, Detroit, Mich.*

★ May Contest Prize Winner

One of the simplest methods of measuring fluid flow rates is by determining the impact pressure of the fluid. This is ordinarily accomplished by means of a Pitot tube, i.e., by a tube inserted into the flowing stream in a direction parallel to the flow of the fluid. The impact pressure is the difference between the pressure exerted by the fluid in the Pitot tube and the static pressure exerted by the fluid. The latter is determined in the usual manner by measuring the pressure in a tap which is perpendicular to the flow of the fluid. However, the Pitot tube method has several well-known disadvantages: (1) It samples only a small portion of the stream, thus determining the velocity at that point, but not the average velocity over the entire cross-section of the stream. A velocity traverse across the stream is generally necessary to overcome this difficulty. (2) Owing to the smallness of the opening in the Pitot tube, it collects solid particles easily and tends to clog up. (3) The Pitot tube must be inserted parallel to the fluid stream, any accidental departure from this direction resulting in an error. On the other hand, the great advantage of this method is the fact that it offers virtually no resistance to flow, and hence causes practically no pressure drop.

A simple impact flowmeter can be made which will have the advantage of causing virtually no pressure drop, and which will not have the disadvantages of the Pitot tube. The solution to the problem is simply to determine the impact pressure of the *entire* stream, all at once, instead of determining it only at some single point in the stream. This can be accomplished by causing the fluid to change its direction, e.g., by causing it to flow around a 90-deg. bend. The static pressure is determined in the usual way, by means of a tap perpendicular to the original direction of the stream. The total pressure (impact plus static) is determined by means of a tap placed in the elbow or tee, in line with the original direction of flow, as shown in the accompanying figure.

The flow rate determined by such a "meter" follows the formula

$$Q = CA\sqrt{2g\,\Delta P/\rho}$$

where Q is the volumetric flow rate, A is the cross-sectional area of the pipe, g is the gravitational constant, ΔP is the impact pressure (i.e., total minus static pressure), ρ is the density of the fluid, and C is a constant for a given meter.

As an example, the following data were obtained for the flow of air, using a meter consisting of ½-in. pipe and ½-in. tees.

Q, CFM.	ΔP, In. H_2O	Reynolds Number	Constant, C
0.686	0.33	3,990	0.76
0.813	0.44	4,650	0.76
0.963	0.66	5,420	0.74
1.452	1.22	8,300	0.80
2.07	2.58	11,900	0.78
2.73	4.48	14,900	0.76
3.19	6.05	18,300	0.75
3.68	7.43	21,400	0.76
4.02	8.97	23,000	0.75

It will be noted that the coefficient C is essentially independent of Reynolds number in the turbulent range. However, it appears to be necessary to calibrate each such meter individually.

Many variations of this meter may be made. For example, a 90-deg. bend may be made with a cross, or a

★ JUNE PRIZE WINNER—A $50 prize will be issued to . . .

GORDON KIDDOO
Technical Director, Continental Carbon Co., Amarillo, Texas.

. . . for an article which presents a new chart designed for the rapid determination of the linear velocity of flow of gases in pipes of various sizes, at temperatures and pressures of various magnitudes. The winner of our June contest, this article will appear in the August issue.

$50 PRIZE FOR A GOOD IDEA—Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook.

The winner each month will be announced in the issue of the next month, e.g., the July winner will be announced in August and his article published in September. Judges will be the Editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable at space rates.

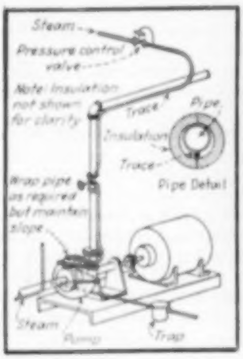
HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible.

Articles may deal with any sort of plant or production "kink" or short-cut that will be of interest to chemical engineers or others in the process industries. Also, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

180-deg. bend may be made with a return bend. More complicated shapes may also be used to change the direction of the flow. For example, the outlet may be an annular ring instead of a pipe; an opening in the center of the plate may then be used as the total pressure tap.

The location of the static pressure tap is not critical, but it should preferably be immediately upstream of the point where the fluid stream begins to be deflected. The total pressure tap must of course be placed in the path which the fluid stream would have taken if it had not been deflected.

In the case of a liquid, it is not necessary to determine the static pressure separately, but a differential manometer may be used to determine directly the difference between total pressure and static pressure. For gases, however, it is generally necessary to measure the static pressure separately, so that the weight rate of flow can be calculated from the volumetric flow rate.



Handling Melted Solids With Unjacketed Pumps and Pipe

George T. Austin, *Associate Professor of Chemical Engineering, The State College of Washington, Pullman, Wash.*

Materials such as 76 deg. Be. caustic soda, stearic acid and similar materials which congeal at room temperature, but melt at the temperature of ordinary steam, can be transported most satisfactorily by pumping. Jacketed pipe and pumps are expensive and occasionally unobtainable, particularly when special materials of construction such as aluminum, stainless steel or Karbate are required because of the corrosive nature of the material being handled. Properly installed outside trace lines have proved to be entirely satisfactory for pumping stearic acid when installed as shown in the sketch. Aluminum or copper tubing will, in general, prove most desirable for the trace lines, although small steel pipe is excellent for long, straight runs. A few simple precautions are necessary to insure trouble-free operation of the installation.

1. The trace line must be sufficiently large to avoid choking with condensate and must be well trapped.
2. All the lines must slope, without any pockets, from the steam feed to the trap. This must be watched carefully when valves and pumps are wrapped.
3. Steam, its temperature controlled to a desirable maximum by the use of a pressure reducing valve, is the preferred heating medium. Ample insulation, carefully applied, is necessary for satisfactory operation.
4. Particular care should be taken with corrosive materials to protect the heating tube from possible drippage from leaking packing glands and stuffing boxes on pumps and valves.
5. Select only best quality pumps with good, deep stuffing boxes to jacket in this manner and select the packing with considerable care.

Pneumatic Control For Mill Level

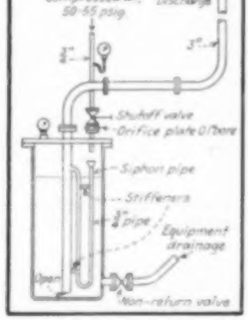
Writing in a recent issue of *Power*, C. Werderitch described a simple pneumatic control for coal level in a ball mill supplying boilers. Electronic controls previously used had given trouble, so the pneumatic arrangement was worked out and has been giving satisfactory control within less than a ½-in. range for over a year.

A ½-in. pipe protected inside a 2-in. extra-heavy pipe enters the mill through the feed end and extends to a point about 2 ft. from the mill discharge. The inner end of the ½-in. pipe is bent down and terminated with a nozzle of larger pipe so that the opening just reaches the coal level under normal loading conditions. The carrying 2-in. pipe is supported on a pivot outside the feed end, with its outboard end supported by an adjusting screw so that the inner, detecting end can be adjusted for elevation. The outer end of the ½-in. pipe is then connected flexibly to a slack-diaphragm draft gage provided with two photocells, and appropriate cut-offs mounted on the draft-gage arm.

At full boiler load the mill pressure is about −0.2 in. H_2O. When the mill level builds up to a point which just submerges the detecting end of the tube, pressure in the tube drops to 0.0 in. Photocell adjustments are such that when the draft gage pressure rises to 0.05 in., the feeder speed is cut to half, and if the pressure rises to 0.0 in., the feeder cuts off entirely.

Automatic Blowcase Lifts Liquids By Steam or Gas Pressure

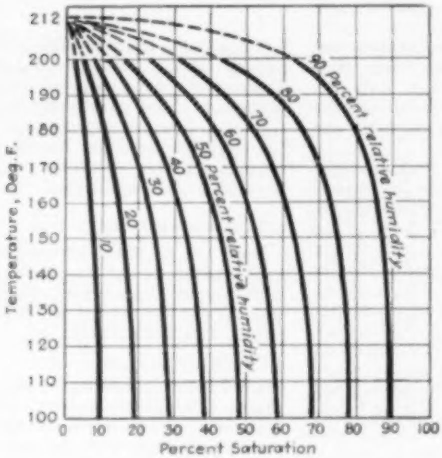
G. Jungnitz, *Professor, State School of Mines, Recklinghausen, Ruhrgebeit, Germany.*



Described here is an automatic blowcase which is simple and foolproof, and can be made readily from materials suitable for the chemical or other properties of the liquid handled. Made of steel it can elevate condensate or other non-corrosive liquids. When constructed of corrosion resisting materials it can handle many liquids which might give trouble in pumps. It can be operated by the pressure of steam, air, or any other gas suitable for the liquid being pumped. This method is particularly convenient for moderate-sized installations and can pump to any height dependent only on the specific gravity of the liquid and the available gas or steam pressure.

The blowcase has no moving parts. Liquid enters by gravity through a non-return valve, flowing into a closed vessel which in the particular installation described has a capacity of 180 gal. The dimensions and quantities given are for this installation and must be modified to suit conditions in other cases. Air, steam or other gas enters through

a ⅜-in. line fitted with an orifice plate having a bore of approximately 0.1 in. While the vessel is filling the gas escapes (steam condenses) by the 3-in. riser pipe. However, as soon as the rising liquid closes the inlet of the siphon pipe, the internal pressure builds up and forces the liquid up the riser until the vessel has been emptied, except for the small volume below the riser inlet. In the case described pressure reaches about 10 psig. for a 21-ft. static discharge head. Filling requires about 3 min. and discharge about 4.5 min. As soon as the siphon is cleared, atmospheric pressure is restored to the vessel and liquid again enters through the check valve.



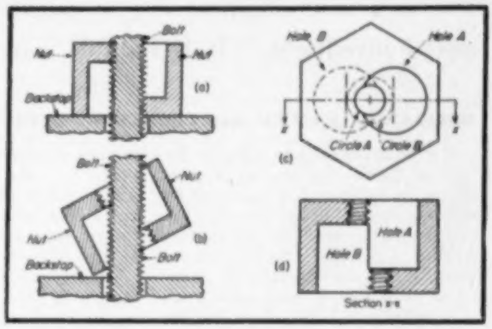
Relation Between Relative Humidity And Percentage Saturation

Joseph T. Hogan, *Chemical Engineer, New Orleans, La.*

The moisture content of gases may be designated in several ways but the index commonly employed by the engineer is that of the relative humidity of the mixture. Relative humidity is the ratio, usually expressed in percent, of the pressure of water vapor present in the gas, to the saturation pressure of water vapor at the temperature of the gas. In practice, relative humidity is sometimes defined as the ratio of the weights per unit volume of the water vapor in the gas mixture, and the saturated vapor at the temperature of the gas mixture. This latter definition of relative humidity is more properly termed percentage saturation. Both terms, however, differ from the absolute humidity of a gas, which is the weight of water vapor per unit volume of mixture, i.e., grains per cubic foot.

In the literature the terms relative humidity and percentage saturation are often used interchangeably and are considered equivalent for all practical purposes (Nat. Bur. Stand., Instruments for Measuring Humidity, LC946, 1949). While it is true that for temperatures of 100 deg. F. and lower, the relative humidity and percentage saturation are essentially equivalent numerically, these two quantities differ widely for temperatures in the range of 100-200 deg. F.

The accompanying chart illustrates the differences existing between the relative humidity and percentage saturation for air over the temperature range 100-200 deg. F., for an atmospheric pressure of 29.53 in. of mercury. The curves have been extrapolated for the range 200-212 deg. F. and are shown as dotted lines in the chart. It is interesting to note the degree of variation for the higher temperatures of air. For example, at 194 deg. F. and a relative humidity of 90 percent, the percentage saturation is 70 percent. This means that the air has 70 percent of the weight of water vapor necessary to saturate it at 194 deg. F.



Quick-Lock Nut Is Useful For Equipment Closures

Walter G. Thomson, *Minneapolis, Minn.*

In many kinds of equipment, for example, batch type ball mills, it is necessary to have a removable door or panel which is secured during operation by bolts and nuts spaced around the periphery of the door. Especially where the operating cycle is short, opening and closing such an arrangement tends to become an important time factor, and particularly when opening to take samples is required at frequent intervals.

The unique type of nut described here largely overcomes these difficulties, since it can be disengaged and slipped off the bolt after about one complete turn. Sketches *a* and *b* are cut-away views of the nut. Sketch *a* shows the nut in the engaged position, tightened against the "backstop." In sketch *b* the nut has been disengaged and tilted for slipping off the bolt. Sketches c and d together show how the nut is constructed.

Referring to sketch c, which shows a top view of the nut, circle *A* represents the inside of the threads and circle *B* the root of the threads. Holes **A** and *B*, which should intersect each other on or slightly outside circle *B*, have their centers on the same straight line with circles A and *B*. Each of these holes is machined about two-thirds of the way through the nut, one from the top and one from the bottom. The cross-section in sketch d shows what the finished result will be. The threads are exaggerated, of course, to make the construction clear.

It will be readily apparent how the nut works. When it is tipped the threads disengage and allow it to be slipped along the bolt. To engage it, it is slid into position and rotated in a clockwise direction from the position of sketch *b* until it lies flat on the backstop. A turn or so in the usual manner then pulls it up tight. Analyzing the forces involved, it is clear that the horizontal components of the forces at the thread will be equal and opposite, but the vertical components, although equal, will form a couple which means that the reaction from the backstop will be greater on the lefthand side, thus causing the nut to tighten harder on that side. The practical consequence of this, of course, is that the nut will not lock unless it is tightened against some rigid surface.

Before investing in new production facilities. . .

Calculate Payout Time for Your

This is a new empirical way to calculate the time it will take to pay off a capital investment. It is versatile, easy to use, may help you keep your capital

WILLIAM L. FAGLEY and GEORGE W. BLUM

It is often desirable to calculate the "payout time"—the number of years before an investment is recovered by added earnings—before investing in new production facilities. This is true whether it is a new enterprise, an expansion, or a diversification of an existing plant that is being considered. A calculation will often show that the risks from a payout period that is too long do not justify interrupting an existing capital structure that may be smaller but secure.

Normally, payout time should be determined to compare (1) the attractiveness of several possible new ventures, (2) the attractiveness of a single venture of relatively high risk, or (3) the relationship between the payout time and the expected life of the new facilities.

WILLIAM L. FAGLEY, *now with Dow Chemical Co. in Midland, is a recent chemical engineering graduate of Case Institute of Technology. Coauthor* GEORGE W. BLUM *is assistant professor of chemical engineering at Case.*

All empirical methods of determining payout time that are in common use are based on limiting assumptions; this requires a careful choice of the method to use. Their complexity varies a great deal, depending on the number of factors that are considered. Many of these factors have a marked effect on the accuracy of the calculated time; hence the various methods give a wide variation in the payout time. We suggest in this article a new empirical relationship that we believe will be (1) more accurate, (2) more versatile, (3) easy to use.

The classical calculation is simply to divide the investment by the gross earnings that it makes possible.[1] This neglects interest charges and taxes. Therefore it gives a distorted picture of the cost of the invested capital. It does have, however, the advantage of being easy to determine. Nor does it require estimates of uncertain tax rates, interest or depreciation.

BUELL'S TWO METHODS

Buell[2] has given a more acceptable method which is also easy to use. It takes into consideration the tax rate on earnings and indicates a depreciation factor. The Buell formula is:

$$T = I/Z \qquad (1)$$

where I is the investment in new facilities; Z is $S(1-t) + tD$; S is the net annual savings made possible by the new facilities; t is the tax rate applicable to earnings; D is the annual depreciation for tax purposes.

Fagley-Blum Methods of Calculating Payout Time at End of Payout Period

	By 3 Percent Debenture Bonds Original	By 3 Percent Debenture Bonds Alternate	By 4.5 Percent Preferred Stock Original	By 4.5 Percent Preferred Stock Alternate	By Retained Earnings or Common Stock Original	By Retained Earnings or Common Stock Alternate
Equation for T*	$\frac{I}{(1-t)S-I(i+r-n)}$	$\frac{I}{(1-t)S+I(n-i)}$	$\frac{I}{(1-t)S-I(2r''-n)}$	$\frac{I}{(1-t)S+I(n-r'')}$	$\frac{I}{(1-t)S-I(2r'-n)}$	$\frac{I}{(1-t)S+I(n-r')}$
Payout time in years	4.72	4.14	5.89	4.66	7.70	5.13
Accumulated net profit†	$906,000	$793,000	$1,235,000	$977,000	$1,625,000	$1,078,000
Depreciation reserves on new facilities at end of period	236,000	207,000	295,000	232,000	375,000	256,000
Total interest or dividend payments during period	142,000	124,000	265,000	209,000	500,000	334,000
Retained net profit from new facilities	906,000	793,000	970,000	768,000	1,125,000	744,000
Book value of new facilities at end of period	764,000	793,000	705,000	768,000	625,000	744,000
Excess of retained net profit over book value of new facilities	142,000	0	265,000	0	500,000	0

* See text for explanation of formulas and of nomenclature. † After interest and taxes when debenture bonds are used; after taxes before dividends when preferred stock, retained earnings or common stock are used.

To compare the various methods of calculating payout time, we will assume that the company plans to invest $1,000,000. The new plant will yield a net profit before taxes and interest or dividends of $350,000 per year. It will be depreciated $50,000 per year or at the rate of 5 percent for 20 years. We will assume that total taxes on income from all sources are at the rate of 40 percent. The present rate of earnings on the company's common stock is 6.5 percent. The new production facilities may be financed by debenture bonds at 3 percent interest or by an issue of preferred stock at 4.5 percent. Then, $I = \$1{,}000{,}000$; $S = \$350{,}000$; $D = \$50{,}000$; $t = 0.40$; $r = 0.03$; $r' = 0.065$; $r'' = 0.045$; $i = 0.018$; $n = 0.05$.

These tables compare the length of the payout period when the different formulas given in this article are used. In them we have assumed (1) that the yearly profit before interest and taxes is constant over the payout period and (2) that the tax rate on earnings, yearly depreciation, interest and/or dividend rate is constant over the payout period.

Example: Compares results from the several ways for calculating payout time

Investment

structure sound.

This method is not fully adequate; it fails to take into account the interest rate, cost of getting the capital, or the full value of the yearly reserve for depreciation. Buell has, however, suggested a revised method for calculating payout time that includes several of these factors:

$$T = \frac{\log Z - \log (Z - iI)}{\log x - \log y} \qquad (2)$$

where Z, T, t, and I have the same relationship as in Eq. (1) and i is $(1-t)r$ or the effective rate of interest; x is $1 + i/2$; y is $1 - i/2$.

Yet this method is limited. It cannot be used when the new investment is financed by retained earnings or from the sale of common stock; nor can it be used under any capital financing where the effective rate of interest is zero. The method does not give full recognition to yearly depreciation. In addition, it is just often not convenient to use five-place logarithm tables.

Buell Methods of Calculating Payout Time

	Simplified Method	Log Method
Equation for T*	I/Z	$\dfrac{\log Z - \log(Z - Ii)}{\log x - \log y}$
Method of financing ...	Ignored	3% deb. bonds
Payout time in years...	4.17	4.54
Accumulated net profit†	$875,000	$870,000
Depreciation reserves on facilities at end of period	208,000	227,000
Total interest payments during period		136,000
Retained net profit from new facilities	875,000	870,000
Book value of new facilities at end of period	792,000	773,000
Excess of retained net profit over book value of new facilities	83,000	97,000

* See text for explanation of formulas and nomenclature. † After interest and taxes.

The differences in results from Eqs. 1, 2, 4 and 5 are not too great; this is especially true when original estimates of the magnitude of the investment and net profits are made prior to actual getting of the capital. However, Eq. (4) gives the most conservative answer. Thus any deviation between estimated requirements and actual requirements is minimized.

All established ways of calculating payout time assume that net annual earnings, tax rate and interest rate are constant. When the tax rate and net annual earnings vary, then the payout time must be calculated stepwise, year to year; this takes the variations into account so that the capital recovered each year can be determined.[3] This method gives the most reliable value for payout time. But the calculation becomes tedious and time-consuming.

OUR NEW METHOD

We suggest a new empirical relationship that (1) eliminates many of these tedious calculations and (2) can be applied to new capital investment that is financed by common stock issue, use of retained earnings, issue of preferred stock or the assumption of new bonded indebtedness.

New production facilities may be considered paid off when the accumulated net yearly profit after taxes and interest charges is equal to the *adjusted investment*. After T years, the investment will not necessarily be I; the facilities have been depreciated by an amount TIn, with an interest payment of TIr to bond or note holders. Thus, after T years the capital investment in the new facilities will be $I - TIn + TIr$. Since the adjusted investment must take into account the full amount of interest paid to bondholders, the use of the full interest rate would be more valid than the effective interest rate. When depreciation and interest rates are equal, then I will again represent the total investment at the end of T years.

Yearly profit after investment charges and taxes will be $(1 - t)s - Ii$. Here the effective rate of interest is used since interest expense can be deducted from income taxes. While the bondholders actually receive the full interest (Ir), profits are not reduced by a like amount because of the tax deduction. This accounts for the so-called "effective rate of interest" rather than the "full" interest rate. If the tax rate, yearly earnings before taxes and interest, and interest rate are all constant during the payout time, then:

$$T[(1 - t)S - Ii] = I - TIn + TIr \qquad (3)$$

Thus accumulated yearly net profit is equal to the adjusted value of investment after T years. Here T, I, t, S, i and r are the same as in Eq. (2); n is the percentage of investment depreciated each year, $n = D \div I$.

Thus Eq. (3) may be considered as the basic payout equation. It can be simplified by solving for T:

$$T = \frac{I}{(1 - t)S - I(i + r - n)} \qquad (4)$$

Industrial management now generally favors the financing of new production facilities by "plowing back" retained earnings. Five primary factors should be considered in choosing the method of new financing: (1) how easy and how long it takes to get new capital; (2) actual cost of the capital; (3) terms of the repayment; (4) the degree of risk involved; (5) government policies on taxes and its attitude toward "bigness" of individual corporate enterprise.

New capital is often needed immediately, and there may not be time to sell an issue of preferred stock or debenture bonds. If the capital is not available at once, construction work may be held up long enough to allow a competitive product to capture the best prospective markets. From the cost point of view, issuing bonds or notes is the cheapest financing; issuing preferred stock is more costly; using common stock and retained earnings is most expensive.

This assumes that if the financing comes from retained earnings or the sale of common stock, the new facilities must yield a return on the investment at a rate no less than the present yield on common stock outstanding. Otherwise the stockholders would have been better off if the investment had not been made or had been financed by other sources of capital. This has been shown by Soule in his discussion of the economics of aggressive research[4]: "The financial test of its [research] success is not simply whether or not such an investment returns a profit to the company. It is whether the results thus obtained are enough to produce some net gain to the stockholders."

Bonds and notes (and to a related degree, the preferred stock issue) carry specific stipulations for repayment. They are therefore less desirable as a source of capital for a risk investment. The planned new investment will have a marked effect on the proper choice of capital sources, depending on whether or not it is intended to fit into the company's established experience or products or is to be considered as capitalization for diversification into new and untried fields.

Leon Henderson's opinions[5] repre-

sent those of one segment of political economists. He feels that industry should be discouraged from "plowing back" earnings. He would rather have these distributed to common stock owners. In order to accomplish this, he advocates an increasingly confiscatory tax structure to drain off a high percentage of retained earnings. Henderson's views are based on the likelihood of a greater tax return to the government on individual incomes as well as his fear of an increase in the "bigness" of business. He also fears an increasing independence of corporations for new, small investment capital from outside sources.

Therefore it seems advisable to consider separately the payout relationship that results from various sources of investment financing. If the new production facilities are to be financed by retained earnings or by the sale of common stock, Eq. (4) should be modified so that $r = r'$ = the present yield on common stock. Since dividends are not deductible before taxes, the yearly income will be reduced by Ir' instead of Ir. The payout formula then becomes:

$$T = \frac{I}{(1-t)S - I(2r' - n)} \tag{4a}$$

This formula can be used for financing by common stock or by retained earnings. If a preferred stock issue is used to finance the new investment, then r'' or the rate of preferred dividend will replace r' in Eq. (4a).

Where mixed financing is used, the payout formula will be:

$$T = \frac{I}{(1-t)S + In - 2aIr' - bI(r+i) - 2cIr''} \tag{4b}$$

Stated, this becomes: payout time in years = investment ÷ (company share of profits after taxes + yearly depreciation − cost of common stock financing − cost of bond financing − cost of preferred stock financing). Here a, b and c are the fractions of the investment financed by retained earnings and/or common stock, bonds, or preferred stock respectively. The ease with which this formula can handle all methods of financing the new investment is a considerable advantage over other methods of calculating payout time.

Should the cost of financing be included when calculating the adjusted investment? This is controversial. Therefore, alternate proposals are given for the relationship shown in Eq. (4). These are based on the assumption that interest charges and dividends are current expenses—hence are not valid factors in estimating the investment value after a given period of years. Thus the following relationships do not consider dividends and interest payments in the adjustment of capital investment:

For financing by bonds:

$$T = \frac{I}{(1-t)S + I(n-i)} \tag{5}$$

For financing by common stock or retained earnings (use r'' for preferred stock financing):

$$T = \frac{I}{(1-t)S + I(n-r')} \tag{5a}$$

For financing with capital obtained from varied sources:

$$T = \frac{I}{(1-t)S + In - aIr' - bIi - cIr''} \tag{5b}$$

The alternate proposal is less conservative than the basic payout formula (see tables). Any error in estimating such factors as tax rates, magnitude of investment and yearly earnings may become magnified to such an extent that the investment may be undertaken without fully realizing the risks involved. Because of the varying degrees of conservatism shown by many corporations today, the alternate proposal has been included as an aid in making a more judicious choice of payout formula.

Advantages of using Eq. (3) for calculating payout time are: (1) the true effect of interest is shown with greater emphasis; (2) it shows what effects taxes have on earnings; (3) it recognizes the full effect of depreciation reserves; (4) it is readily modified to handle different methods of financing the new investment; (5) it is a more conservative way of calculating since it includes the interest paid out to finance the investment (see examples). In addition, Eqs. (3) and (4) are just as readily solved for S, the net yearly profit, if an allowable maximum payout time is known.

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SLIDE RULE TRICKS

How to get more work out of your slipstick. You can combine constants and make the rule pinch hit for tables of data.

HENRY ECKHARDT

Nomographs are widely used in order to facilitate engineering calculations. Such aids to computation are useful; however, the engineer often forgets that he has on hand an adjustable two variable nomograph which is suitable for the solution of a wide variety of problems—the slide rule. We are not concerned here with the use of the slide rule for solving the equations of engineering in the customary manner, although a few ordinary manipulations are involved in the solution of certain problems considered. Rather a method is outlined for obtaining the solution of several physical and engineering functions which are not ordinarily accomplished with the slide rule, either because the necessary steps by the ordinary methods are too involved, or because there are no known analytical functions.

Crux of the method is to combine the constants of the function into a single constant which is used as a gage point on the slide rule, and, when necessary, to alter the form of the function to a type which can be solved with a slide rule by a single setting. For example, the equation in common use for the Reynolds Number function for clean standard steel pipe[1].

$$\phi N_{Re} = 0.0001906 + [0.01171/(N_{Re})^{0.35}] \tag{1}$$

This requires at least two settings of the slide rule and a four-figure addition; moreover, for part of the range of Reynolds Numbers occurring frequently in practice, the Reynolds Number falls off the scales of an ordinary slide rule, thereby necessitating two additional settings of the rule; however, D. S. Davis[2] has shown how this function can be solved in a single setting of the slide rule, which in effect, employs another equation approximating Eq. (1) in the desired range.

This article presents the methods for obtaining by means of a log-log slide rule a solution of the following relations:

- Wire gage—Wire diameter.
- Reynolds Number function—Reynolds Number.
- Hydraulic friction factors—Reynolds Number.
- Temperature—Vapor pressure of steam.
- Temperature—Vapor pressure of other liquids.
- Temperature—Vapor pressure of ammonia.
- Temperature—Enthalpy of evaporation for steam.
- Temperature—Total enthalpy of saturated steam.

All of the above relations are solved directly in the common engineering units.

In order not to have the proposed methods appear formidable, only the basic outlines of the methods are given here. It is assumed that the reader is entirely familiar with all the terms mentioned and the background. Furthermore, to condense this article, no derivations are given, and when not necessary, even the equations are omitted, and only the slide rule settings are given. In passing, it should be noted that the slide rule has much greater precision than is required for most data that are slipped on it. It is assumed that the reader is aware of the actual precision of ordinary physical and engineering data, and moreover, the magnitude of the deviations of the actual prime variables from the assumed or measured values used in a computation.

To simplify some of the solutions, they are expressed directly in terms of the slide rule settings. Illustrating the convention employed, the following example should suffice:

The relation between the diameter and area of a circle is given by the equation

$$a = \pi d^2/4 \tag{2}$$

The equivalent slide rule setting is denoted by

$$C(1)/D(d) = A(a)/B(\pi/4) \tag{3}$$

The capital letters denote the scales of the slide rule and the letters or figures in the parentheses denote the corresponding scale reading. Obviously, the same slide rule designation is employed in solving for either a or d.

WIRE GAGE—WIRE DIAMETER

The wire diameters in the AWG or B&S gage for successive gage sizes[3] are in the ratio of $92^{1/39}$. The full scale ranges from No. 0000, the largest, to No. 40, the smallest, pivoted about the No. 36 gage, which is taken at 5 mils diameter. There is the choice of several methods for obtaining this simple analytical relationship on the slide rule. The method which gives the result in a single setting for all gage sizes over the entire scale is based on a calculation which pivots the scale on a hypothetical gage of 49.88. . ., which would be one mil in diameter. In place of setting the ratio $92^{1/39}$ (1.122932. . .) on the LL2 scale, it is more convenient to employ the gage point 1159 on the D scale. The method is exact; the accuracy is limited only by the precision of the slide rule employed. Let d = wire diameter in mils, G = gage number (algebraically). (Thus, a No. 0000 wire is −3 on an algebraic scale.) Then the slide rule setting is

$$C(1)/D(1159) = C(49.88 - G)/LL3(d) \tag{4}$$

The left index of the C scale is used for all settings.

Example—Find the diameter of a No. 10 B&S gage wire.

Set the left index of scale C opposite the constant gage point 1159 on scale D. 49.88 minus the gage size, 10, is 39.88. Then opposite 39.88 on scale C, find 102 on scale LL3. The wire diameter for a No. 10 B&S gage wire is thus 102 mils. (See Fig. 1, p. 120.)

Example—Find nearest B&S gage size for a 0.020-in. diameter wire.

Same setting of slide as for above example. It is only necessary to move the indicator to a new position. Thus opposite 20 on scale LL3, find 25.84 on scale C. Then the gage size, G, equals 49.88 minus 25.84, or 24.04. Thus the given size is slightly smaller than a No. 24 gage, the latter being 20.1 mils diameter. (See Fig. 2, p. 120.)

There are two other slide rule solutions, although these are not as practical generally: one is pivoted on the No. 36 gage, and the other on a No. 30. These two methods

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HENRY ECKHARDT, *Industrial Consultant of Bayside, L. I., was the sparkplug on our articles on equipment cost. Here he has come up with another idea to help you.*

have the advantage of integral exponents, but a second setting is required on the slide rule for all wire sizes smaller than the pivot size. Moreover, the former method requires an additional mental multiplication, and the latter is an approximation.

REYNOLDS NUMBER FUNCTION

The Reynolds Number function is used to determine the fluid friction head by means of the modified Fanning equation.[6]

$$F = \phi N_{Re} L u^2/D \qquad (5)$$

where ϕN_{Re} = the Reynolds Number function, F = fluid friction head, feet of fluid flowing, L = length of pipe, feet, D = inside diameter of pipe, feet, u = velocity of stream, feet per second.

Reynolds Number function is a condensation of the fluid friction factor, f, and the constant term $2/g_c$ which occurs in the original form of the Fanning equation. (See Eq. 14, p. 377 in Perry.[6]) Thus[6]

$$\phi N_{Re} = 2f/g_c \qquad (6)$$

where g_c = 32.17 $lb._m$ ft./$lb._f$ $sec.^2$ is the dimensional constant. Following this section a similar condensation of factors is suggested which will expedite the calculations for determining the Reynolds Number itself.

Pipe friction factors vary with the state of flow—viscous or turbulent—the nature of the interior pipe surface, varying from the smoothest drawn tubing to the heavily incrusted iron pipes. Viscous, or streamline flow, is considered to hold up to about N_{Re} 2,000, and stable turbulent flow from about N_{Re} 4,000 upwards. For the unstable transition zone it is safer to take the friction factors for N_{Re} 4,000 in the turbulent condition. Also for Reynolds Numbers above two million use the minimum value of the friction factors corresponding to N_{Re} 2,000,000.

In the viscous flow region the fluid friction is independent of the internal pipe surface conditions. The equation is

$$\phi N_{Re} = 1/N_{Re} \qquad (7)$$

In the region of turbulent flow the fluid friction is dependent on surface conditions inside the pipe. Several slide rule nomographic solutions are available for new commercial steel pipe. Reference has been made already to Davis[8] who devised a method for obtaining the Reynolds Number function, or friction factor, from a single setting of a log-log slide rule. His method has been modified so that the gage points are set on the log-log scale, which results in settings which are more convenient for mnemonic reasons. The modified slide rule setting for the turbulent range of N_{Re} from 4,000 to 2,200,000 is

$$C(1)/LL3(N_{Re}/100) = C(10^4 \phi N_{Re})/LL3(GP) \qquad (8)$$

where GP denotes the gage point employed (other symbols as before). For all cases, the right hand index of scale C is employed. The factor 10^4 set before the Reynolds Number function on scale C locates the decimal point properly, the C scale is assumed to range from 1 to 10; however, in actual use it is simplest to disregard this factor, since all values of the Reynolds Number function in the turbulent range have three zeros after the decimal point.

As a first approximation, a gage point of 11 is generally applicable for practical calculations. Useful range: N_{Re} 4,000 to 1,000,000.

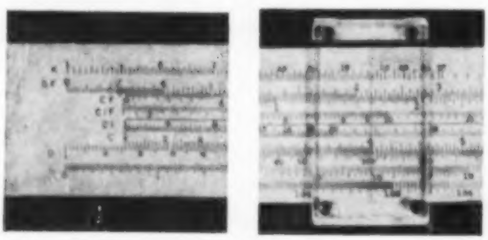
Example—Find the Reynolds Number function for a Reynolds Number of 50,000.

Referring to Eq. (8), set the right C index opposite 500 on the LL3 scale. Opposite the gage point 11 on the LL3 scale, find 386 on the C scale. Place the decimal point followed by three zeros before this reading and obtain 0.000386 for the Reynolds Number function. The value computed by Eq. (1) is 0.000382; consequently, the value computed by slide rule is only about 1 percent greater. (See Fig. 3 below.)

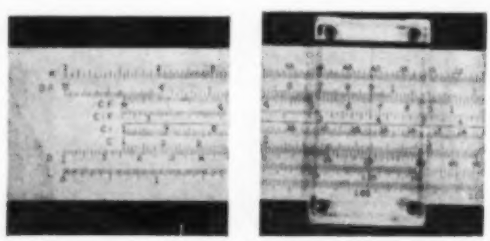
It should be noted that the empirical data on which Eq. (1) is based scatter widely, and the deviation between data and Eq. (1) may be as much as ±10 percent. Despite this, at times it may be expedient to have the solution by slide rule correspond even closer to Eq. (1), for the sake of having calculations which will agree with those made by

Sample Settings

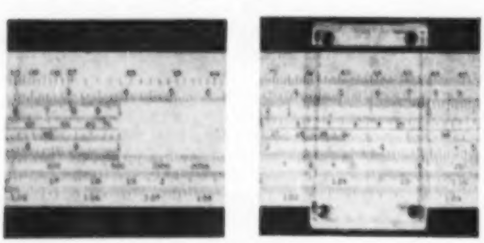
See text for how and why these results are obtained



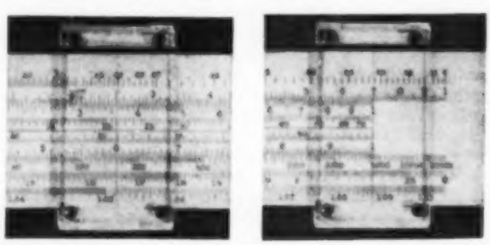
1—No. 10 B & S wire is 102 mils.



2—0.020-in. wire is No. 24 B & S gage.



3—N_{Re} = 50,000; Reynolds Number function = 0.000386.



4—Steam at 150 psia. is 360 deg. F.

other methods, although intrinsically the accuracy of the experimental data does not justify this.

Second approximation: The gage point 11 is restricted to the range above about N_{Re} 20,000, and a second gage point of 12.5 is used in the lower turbulent range from N_{Re} 4,000 to 20,000.

Third approximation: In order to secure still closer agreement with Eq. (1), one can obtain a simple correction term from the slide rule with which to adjust the gage point in the range from N_{Re} 20,000 to 2,200,000, so that the maximum error is under 1 percent. The variable gage point is obtained by adding 300 times the reading on scale LLO3 to the constant 10. This reading is obtained when the right hand index of the slide is set opposite $N_{Re}/100$. The correction term is carried to only one significant figure after the decimal point, and the simple calculation is performed mentally. Thus, in the form of an equation, the variable gage point as a function of the Reynolds Number is

$$GP = 10 + 30000/N_{Re} \tag{9}$$

Example—Find the Reynolds Number function for N_{Re} 50,000, using the variable gage point.

As before, after Eq. (8), set the right index of C and the slider on $N_{Re}/100$, (in this case 500) on the LL3 scale. On LLO3 find 0.002,—multiply by 300 and get 0.6,—plus 10 gives 10.6 for the variable gage point. Opposite 10.6 on scale LL3 find 380, or ϕN_{Re} equals 0.000380. The exact value by Eq. (1) is 0.000382, a difference of about 0.5 percent.

The applicability and precision for the three methods are summarized in the following table.

Gage Point	Applicable Range of Reynolds Numbers	Root-Mean-Square Deviation From Eq (1), Percent
11	4,000—1,000,000	<3.7
11	20,000—1,000,000	<3
12.5	4,000— 20,000	<1.7
$10 + 30{,}000/N_{Re}$	20,000—2,200,000	<0.5

FRICTION FACTORS "f"

Since the use of the Reynolds Number function is more convenient than the use of the friction factors, the latter are necessary only for correlating calculations with other work; consequently, for such occasional use the most convenient way is to determine the Reynolds Number function in the usual way with the slide rule using either Eqs. (7) or (8) depending on the conditions of flow, and multiply this value by the conversion factor 16.09, since by Eq. (6)

$$f = \tfrac{1}{2}\, g_c\, \phi N_{Re} = \tfrac{1}{2}\, 32.17\, \phi N_{Re} = 16.09\, \phi N_{Re} \tag{10}$$

The f referred to here is the Fanning friction factor used in chemical engineering treatises.[*] The f used in hydraulic treatises is applicable to the Darcy equation[*] and it is exactly four times as large as the former f. Thus

$$f_{Darcy} = 4\, f_{Fanning} \tag{11}$$

For most practical purposes, the conversion factor for converting from Reynolds Number function to friction factors may be taken as 16 and 64 for use with the Fanning and Darcy equations, respectively.

Engineers having frequent use for the f friction factors may find it more convenient to determine them directly by means of their corresponding gage points. Determination of these supplementary gage points is left to the reader. Hint: the required gage points may be taken on any of the fixed scales of the slide rule. For example, multiplying the Reynolds Number function by 16.09 per Eq. (10) is equivalent to altering the gage point 11 on the LL3 scale to approximately 47 on the LL3 scale, or better still, precisely 0.68 on the LLO2 scale.

COMPUTING THE REYNOLDS NUMBER

In passing, a hint is given of a method for computing the Reynolds Number quickly. The work of computation is shortened by combining all the conversion factors into a single constant suitable for the system of units employed. E. M. De Forest has shown how this can be done, and he has presented his condensed conversion factor in a set of three tables[*]; however, since the factor is constant the Reynolds Number can be found directly from the slide rule, thereby obviating the need for double entry tables and interpolation. Briefly, the crux of the method is to take water as a reference liquid and assign unit specific gravity and unit viscosity to it. Water at 68 F. deg. has a viscosity of 1 centipoise; consequently, the specific viscosity of any fluid (compared to water at 68 deg. F.) is numerically equal to its viscosity expressed in centipoises, the latter unit being the most commonly employed in reference tables. Similarly, specific gravity is numerically equal to the density expressed in the metric system. Indeed, these units are commonly confused, although practically it makes little difference.

Consider the flow of water at 68 deg. F. at moderate rates where Q = flow gallons per minutes and d = denotes the inside pipe diameter, inches. Then,

$$N_{Re} = 3{,}160Q/d \tag{12}$$

For any liquid at any temperature multiply Eq. (12) by the specific gravity and divide by the specific viscosity of the liquid, thus

$$N_{Re} = 3{,}160\, Q(SG)/d(SV) \tag{13}$$

where SG = specific gravity and SV = specific viscosity.

Example—What is the Reynolds Number for a 40 percent sucrose solution at 20 deg. C. flowing at the rate of 80 gpm. in a 3-in. Sched. 40 pipe?

Original data: I.D. of 3-in. Sched. 40 pipe is[*] 3.068 in.; SV of sucrose solution is[*] 6.223; SG of sucrose solution is[*] 1.1764. Substituting these in Eq. (13)

$$N_{Re} = (3{,}160)\,(80)\,(1.176)/(3.07)\,(6.22) = 15{,}570 \tag{14}$$

SATURATED VAPOR PRESSURE OF WATER

The saturated vapor pressure for water can be determined approximately from a single setting of the slide rule and a simple mental calculation by means of the following equation[*]

$$t = 200\,(p)^{1/6} - 101 \tag{15}$$

where t = temperature, degrees F., and p = pressure, saturated water vapor, pounds per square inch, absolute.

This equation gives results correct to within 3 deg. F. in the range from 1 to 350 psia.; conversely, the maximum error in the computed pressure may be 6 psi. at 350 psia. Even at 1,000 psia. the calculated temperature is only 22 deg. F. too low, which represents an error of less than 5 percent of the temperature range from normal terrestrial temperature to the temperature of the steam, at 545 deg. F. This equation is therefore sufficiently accurate for most heat transfer calculations, and it has considerable application to practical problems involving the determination of steam temperature-pressure relation when a steam table is not at hand.

Example—What is the temperature for saturated steam at 150 psia? (See Fig. 4, p. 120.)

By slide rule: $150^{1/6} = 2.305$; multiplying mentally by 200 = 461; subtracting 101 yields 360 deg. F., the answer. The value given in current steam tables is 358.43 deg. F.

Example—What is the pressure for saturated steam at 150 deg. F?

Adding 101 to the temperature = 251; dividing mentally by 200 = 1.255; by slide rule 1.255⁶: 3.91 psia., the answer.

The value given in the steam table is 3.726 psia.

VAPOR PRESSURE OF LIQUIDS

The classical functions for calculating vapor pressures are not adapted well for slide rule manipulations; moreover, it requires a minimum of two constants for each substance. For example, the equation may be[8]

$$\log_{10} p = B - 52.23A/T \qquad (16)$$

A much simpler vapor pressure—temperature function which approximates the true values for many substances can be derived from Eq. (15) by application of the principle of the Duehring Rule. This equation is adapted for slide rule computation and it requires only a single datum for any substance, its normal boiling point. When necessary, any other point on the vapor pressure—temperature curve could be utilized instead, although this would involve the additional step of first finding the normal boiling point for the substance. Without detailing the matter explicitly, it is sufficient to state that there is a substantially fixed temperature difference between two liquids compared at the same vapor pressure. This approximation is closest for chemically similar substances. For our present purpose water is taken as the reference liquid, for which we already have a simple function for the pressure—temperature function, Eq. (15). Thus, the general equation becomes

$$t + 101 + (212 - NBP) = 200p^{1/6} \qquad (17)$$

where N.B.P. = normal boiling point degrees F., for the subject liquid and p = the corresponding vapor pressure, psia.

The two constants may be condensed into one and the equation rewritten

$$t = NBP - 313 + 200(p)^{1/6} \qquad (18)$$

which holds approximately for nearly all liquids.

This equation will give good results whenever the slope of Duehring Line is substantially equal to unity, and when the curvature of the line is slight. Unfortunately, one can not predict the degree of precision, although even chemically dissimilar substances may yield satisfactory results. The disadvantage can be obviated when the engineer deals frequently with the same liquid, so that beforehand the precision and useful range of pressure and temperature for Eq. (18) are known.

In order to illustrate the accuracy attained, the results of some calculations made for several substances selected at random are given:

Substance	NBP, Deg. F.	Given Pressure, Psia.	Corresponding Temperature, Deg. F. Calc.	Actual[8]
Ethanol	173	22.96	197	194
Diethyl ether	94.3	3.583	29	32
Methanol	148.5	36.65	200	200
Carbon bisulphide	115.3	306	322	356
Bromine	137.8	1.274	33	32
Ammonia	−28.1	53.73	47	25

The data and calculated value for ammonia are included in the table in order to illustrate a failure for Eq. (18). This is because the Duehring Line for ammonia with water as the reference liquid has a slope of about 1.44—a 44 percent deviation. Obviously, in order to obviate large errors it is necessary to devise another simple equation for the vapor pressure—temperature relationship for ammonia:

$$t = 110p^{0.1\text{[illegible]}} - 216 \qquad (19)$$

Symbols and units are the same as before. The maximum error does not exceed 2 deg. F. over a range of temperature from −100 deg. F. (1.24 psia.) to 175 deg. F. (~600 psia.); consequently, this equation is applicable to ordinary refrigeration calculations.

It might be expected that Eq. (19) would be the prototype equation for another family of substances. To the contrary, however, a comparison with several alkylamines showed that ammonia appears to stand alone as a chemical substance since better correlation could be obtained for such compounds by using water as the reference substance.

The equations devised for water and ammonia illustrate how the field of application can be extended for other substances. Whenever the slope of the Duehring Line plot departs appreciably from unity, a prototype approximate equation could be devised to give the vapor pressure—temperature relation for any given liquid.

ENTHALPY OF SATURATED STEAM

When a steam table is not at hand, both the enthalpy of evaporation and the total enthalpy for the saturated vapor can be calculated by means of the following equations:

Enthalpy of evaporation:

$$h_{fg} = 142(676 - t)^{0.380} \qquad (20)$$

Enthalpy of saturated vapor:

$$h_g = 1{,}828 + t - (1{,}260{,}000)/(1{,}618 - t) \qquad (21)$$

where t = temperature, degrees F. and enthalpy is expressed in units of Btu. per pound.

Eq. (20) is based on the Henning formula for the heat of vaporization[10] and Eq. (21) is based on the *Power* formula[11] for the total heat of saturated steam. Both equations have been revised in order to have them conform closer to the currently accepted values of the properties for steam, and Eq. (20) has been adapted for slide rule computation. Both equations practically equal the accuracy of a 10-in., slide rule over the full prescribed ranges, and at about 1 atm. pressure the errors for either equation are negligible.

Eq. (20) is valid over the range from 32 deg. F. to about 500 deg. F. The maximum error is under 0.3 percent, and the root-mean-square error is less than 0.18 percent.

Eq. (21) is valid over the range from 32 to about 400 deg. F. The maximum error occurs at the lowest temperature, the error being less than 0.3 percent. The root-mean-square error is under 0.14 percent. The total enthalpy in the range from 400 to about 500 deg. F. can be approximated easily from the fact that this property reaches a maximum of 1,205.0 Btu per lb. at about 454 deg. F., and falls to 1,202.0 Btu per lb. at 500 deg. F. Thus, this function has slight curvature over the range from 400 to 500 deg. F., and the total enthalpies for two states at an equal temperature interval above or below 454 deg. F. are substantially equal.

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News From Abroad

SPECIAL CORRESPONDENCE

Better Days Ahead for U. S.-Brazil Trade

Rio de Janeiro—Trade figures for the first quarter of 1950 point up clearly why American export managers have been wringing their hands over the Brazilian market. Tabulation shows that Brazil's 10 leading imports from the U.S.A. fell more than $53 millions in that period, compared with a year ago.

These same exporters appear to have cause to rub their hands in anticipation of better times to come, however. In the same period Brazil's 10 leading exports to the U.S.A. showed a gain of more than $26 millions over first quarter 1949, boosting Brazil's increasing surplus U. S. trade balance.

British Open New Rubber Research Center

London—The largest rubber research in the British Commonwealth was opened at Fort Dunlop in June. Housing 50 fully equipped laboratories, the center was built by the Dunlop Co. primarily to serve its 25 British and 16 overseas factories, but it will also cooperate with other organizations using rubber or allied products and with the research center recently opened by the company in Malaya.

Brazil's Cement Output To Be Increased

Rio de Janeiro—A $2,070,000 U. S. Export-Import Bank loan to a Brazilian subsidiary of the Lone Star Cement Corp. will add another 100,000 tons to annual cement production in Brazil.

The new plant will be located at Salvador in the northern state of Bahia, where imported cement has been extensively used heretofore. Decomposed coral provides the raw material. Natural gas will be used as fuel.

Owned by the Cia. Bahaiana de Cimento Portland, the plant will cost a total of $4,580,000 when completed.

Brazilian cement production last year was 1,281,000 metric tons.

Ontario May Be Source of Crude Oil Soon

Ottawa—Southern Ontario may provide new sources of oil. While it is not believed there will be oil strikes as extensive as the great oil fields of western Canada, Southern Ontario is definitely in the oil bearing field, it is learned here. Oil companies are said to be looking into the possibilities and are seeking the aid of officials here.

Stratigraphical studies will be made in Southern Ontario this summer by B. A. Liberty and in the vicinity of Niagara by T. E. Bolton.

Western Powers Ease Controls In Germany

Frankfurt—Except for products that can be used only for military purposes, control of the West German chemical industry has been turned back to the Germans by the western high commissioners. The manufacture of some "war" chemicals that also have peacetime uses will be allowed.

New regulations were issued by the commissioners under a recent law to prevent German re-armament and to insure the industrial demilitarization of Germany.

The regulation covering chemicals "leaves the entire field of chemical industry and products free of control" except for particular product. For example, war explosives, certain rocket fuel chemicals and poison war gases without peacetime uses will remain under control.

But the West German government was authorized to allow the manufacture of many "war" chemicals that also are required for a peacetime economy. These include industrial explosives, liquid oxygen, white phosphorus and ammunition for civil security and for sporting purposes.

McGRAW-HILL *World News*

Greece Stops Its Naphthalene Imports

Athens—The Ministry of National Economy has forbidden further imports of naphthalene into Greece, except for obligations already accepted. This decision has been taken because at least half the foreign exchange required for the import of pure naphthalene will be saved by the importation of only the materials necessary for local production.

Canadian Industries Will Make Explosives in Alberta

Ottawa — Canadian Industries Ltd. has acquired 1,200 acres of land about 8 mi. south of Calgary in Alberta area of Canada for the purpose of erecting a commercial explosives plant costing between $3,000,000 and $4,000,000. It will supply the rapidly expanding oil and mineral industries in Alberta and the Northwest territories.

Austria and Brazil Make Chemical Barter Deal

Rio de Janeiro—Austria will ship Brazil more than $1 million in chemical industry products under

(*Continued on p. 225*)

Editorial Viewpoints

"Replete With Commitments"

Manufacturing Chemists' Association has submitted a brief to the Congress and has ably presented by appearance one basic reason against the ratification by Congress of the Havana Charter. This would commit the United States to membership in International Trade Organization of United Nations. Other industries might appropriately study this problem from the point of view which is so well spotlighted by the M.C.A. argument.

By joining ITO the United States could either accept the proposed Charter in good faith, or could offer "lip-service" to it in the thoroughly reprehensible fashion of irresponsible international relations. We know that the American people do not favor the latter semblance of accepting without intention of real support. Any action which is taken by the Congress should be taken with sincerity and with the intent to carry out the direct and the clearly implied commitments. Hence, it is desirable for all of us to note carefully what these commitments are.

Essentially the concept of the Havana Charter is a joining of nations in a program to increase world trade in goods. But the Charter itself goes much further than that. We note a few of the points which MCA justifiably spotlights.

As drafted in the Charter, ITO is intended to do many other things. Here are a few: "to assure a large and steadily growing volume of real income and effective demand," "to increase the production, consumption, and exchange of goods," "to foster and assist industrial and general economic development," "to achieve and maintain full and productive employment," and "to facilitate an equitable distribution of skills, arts, technology, materials and equipment with due regard to the needs of its members."

In other words all this means that the United States would agree to adjust its economy to meet the wishes of the rest of the world. Regardless of what that would do to our economy, we would be compelled to assist the other nations in their general economic development. If we did not make the necessary financial sacrifice, or accept any other drain on our own economy to meet these ends, we could, and undoubtedly would, be charged with bad faith in our agreement.

The objectives sought by our representatives at Havana are unquestionably sound. But our spokesmen made commitments there which are neither safe for America nor constructive for the world. They accepted responsibilities for the United States which they neither understood nor can explain. Congress is now identifying some of them and demanding a clearer interpretation. But it is neither decent nor honest to assume that the so-called "escape clauses" justify us in taking on the appearance of commitments when we have no intention of carrying out the promises made.

It is time we present a realistic approach on what America can do and will do for world welfare—one that can be defined and accepted as a basis of international relations. We make only enemies by insincere diplomatic blundering.

Barter for Benzene?

America needs more benzene, and promptly. Despite radical adjustments to secure a maximum yield of synthetic rubber from a limited supply of styrene, the need continues. New sources of production from petroleum and other raw materials are being developed. Ultimately they will bring us a generous supply of this extremely important raw material. But despite all this effort, we shall be for some months to come short of benzene for plastics, for rubber, and for a multitude of other urgent needs.

One source not adequately being used appears to be the European motor-benzol supply. Both in Britain and on the Continent considerable quantities of this coal chemical are consumed regularly in motor cars. Plans are underway whereby this source can be tapped to the mutual advantage of both European users and American chemical enterprise.

Benzene is used abroad in this way because in the past it has been much cheaper as a motor fuel than the equivalent quantity of high quality gasoline. It appears that this price relationship has now changed. Furthermore, at least one American oil company has been permitted to sell its products to Britain in pounds sterling. Thus it appears quite likely that this petroleum enterprise could take high quality fuel to Europe and trade it for benzene with a real margin of profit for both present benzene users and the petroleum industry.

The desirable characteristics of special gasoline so

used would readily be adjustable to the practical considerations of continental car operation. Certainly the cost of moving the motor fuel from America to Europe and bringing the benzene back is far less than the spread between the present prices of the two commodities.

The nice thing about such a trade is that it requires no new investment. Hence, it can go on just as long as it is profitable. And the new practice can be interrupted at any appropriate time without writing off new plant facilities either here or abroad.

RFC's Proud Record

Congress has been reviewing the activities of Reconstruction Finance Corp. which was created in 1932 under a Republican administration. The 18 years of operation of this government banking agency, as recently presented to the Senate Banking Committee by the RFC chairman, contained facts that we all should ponder.

Reconstruction Finance Corp. has made many billions of dollars of loans with an operating net profit of about $560 million. This profit came after paying all expenses of operation, including salaries, interest to the treasury, and all indirect expenses. Actually, the Treasury received $308 million as dividends; and the capital advanced to RFC has practically all been returned to the treasury. "The operations of the corporation have not cost the taxpayer a single penny," said Chairman Harley Hise.

These facts are particularly important just now when it appears that Congress is going to approve the transfer of RFC to the Department of Commerce. It makes one wonder whether any Secretary of Commerce, present or prospective, is going to be so successful in running an emergency loan business as has the board of RFC. We doubt it. But if the transfer is made we hope that all future secretaries will let the board continue to operate as prudent bankers who are responsible to the American people.

Infringement Again Defined

Repeatedly chemical industry struggles with the question of patent infringement. One of the major difficulties is that a desired end can often be reached both by a patented procedure and by a variation which is not patented. Some courts view this alternate route as open. Others regard pursuit of that route as an infringement of the main patent.

Not often do we get a clean-cut and binding court decision on this question. But on May 29 the Supreme Court of the United States gave us a sharp and reasonable definition which will probably govern in many lower courts from now on. This decision was given in a case in which the issue had to do with using a strictly defined flux in welding or an alternate material which was not specifically mentioned in the patent in question.

The Supreme Court applied again "the doctrine of equivalents." It stated that "though infringement was not literal, the changes which avoid literal infringement are colorable only." It enunciates the principle again that one does not escape infringement by mere use of an alternate composition or an alternate procedure which does not vary substantially from the disclosure or the specific claims of a patent.

This seems to give new strength and support to our old basic idea, namely, that one does not escape the penalty of infringement by using a disclosure of a patent and slightly varying its exact and rigid specifications to achieve a desired result. The Supreme Court's decision will strengthen patents substantially if this interpretation prevails generally in the trial courts throughout the country.

A. H. Winheim, 1906-1950

The American Leather Chemists Association had just concluded its annual meeting at French Lick, Ind. Ade Winheim, who had just rounded out a brilliant two-year term as its president, got in his car and started toward his home in Missouri. With him was his lifemate who had shared so many of his trials and triumphs. Then came the fatal accident that cost Ade's life. Mildred was seriously injured but bravely carries on from her hospital in St. Louis. Their great teamwork that meant so much to so many comes to an end. But their friends can and must make sure that the things Ade Winheim did and believed in shall continue to inspire those who follow in his footsteps.

Ade packed a lot of achievements into his short busy life. In high school he edited the school paper, was on the baseball and debating teams and led his class with a scholastic average of 96. He won a four-year scholarship at Washington University from which he graduated in 1927 with high honors in chemical engineering. Again he led his classmates in extracurricular activities.

Winheim's great interest in the outdoors took him to Alaska for his first job—capturing, tanning and dyeing sealskins. Back in St. Louis he came in 1931 to work for International Shoe Co. and in five years became its chief chemist. Then followed a dozen fruitful years of important research, the invention of the Winheim-Doherty tanning and finishing processes and, finally, in 1948 to his own company to manufacture leather chemicals and to continue research and development.

Would it not be appropriate for those of us who were Ade Winheim's friends and admirers to join in some lasting tribute to his memory? Might there not be an annual scholarship or prize established in his name which would remind future generations of chemical engineers that Ade Winheim made a real contribution to our profession.

How to Cut Costs—14 Practical Tips

These tips on cost reduction in processing plants have helped others. They should help you keep profits up.

MARSHALL SITTIG

1—Make a material balance

One of the most useful tools in reducing costs in the chemical process industries is the use of that old standby —the material balance. A plant office often will carry a raw material consumption figure on its books figured in only one way—perhaps by billed railroad car weights. A check on actual consumption at the point of addition may be quite illuminating. A further check on actual process requirements at this point, confirmed perhaps by an excess of material in ditched residue or wash water, will completely answer the question—"Is every pound paid for doing a useful job insofar as possible?"

EXAMPLE—In a pulp bleaching operation, office records showed a consumption of almost 100 lb. of a bleaching agent per ton of cellulose but plant log sheets indicated a little more than 50 lb. being added to every ton of cellulose. The plant figures simply reflected the standard figures which the operators had been recording, although they had actually been adding a much larger amount. Detailed investigation showed that a saving of 30 lb. of bleach, roughly worth 60c., was possible on every ton. Based on a production of 1,000 tons per month, this item alone yielded savings of $7,200 per year (enough to pay the cost-reduction engineer's salary at least!).

2—Check operating standards

A second approach to cost reduction lies in the comparison of operating standards in the plant in question with other plants' data. When a company conducts the same operation in two places, a comparison may be made, allowing for whatever differences exist. When that approach is not possible, trade associations may be able to furnish average figures for the industry.

EXAMPLE—In comparison of a two-stage bleaching process in one mill with a single-stage process in another mill, it was discovered that one mill used almost three times as much bleach as the other mill per ton of pulp bleached. After allowing for process differences, most of this difference remained as an unexplained discrepancy. Here 100 lb. of bleach, worth roughly $2.00 might be saved on every ton. Based on a production of 1,000 tons per month, this represents a saving of $24,000 per year.

3—Check process efficiency

A re-examination of operating standards in terms of throughput for a given piece of equipment in barrels per day, or in terms of pounds of reagent added per ton of product, is a third step. Such operating standards may be wasteful for one of various reasons. They may have been set up in wartime or another boom production period and may represent maximum production but not maximum economy. They may not reflect modern techniques; even though set up in the past with savings in mind, they may not represent all that can be done with improved instrumentation.

EXAMPLE—There is a tendency of the design engineer to be overcautious. An example is that of a fluid catalytic cracking unit in aviation gasoline operation whose production was increased from 16,400 bbl. per day in August 1944 to 28,000 bbl. per day in June 1945 with consequent reduction in cost per unit product.

4—Cut careless waste with instrumentation

Instrumentation is a fourth inlet to lower costs. Chart records from recording instruments are invaluable checks on how many inches of caustic Jones added at 4 A.M. to the batch that went bad—and other similar questions. Another indirect benefit resulting from instrumenting operations, particularly in older, less highly engineered plants is the psychological value of such instruments. Instances have been noted where no change in process was made but where raw material consumption decreased as soon as level recorders were installed on the raw material metering tanks. One shrewd old veteran asked, as mechanics were piping up the recorders, "What's that? A lie detector?" and decreased consumption figures indicated that the operators had been putting in a little extra for good measure over a period of years prior to this investigation.

EXAMPLE—In the first example cited above, the solution to the problem was finally provided by installation of two liquid level recorders at a cost, including installation, of perhaps $300. Thus, in one year, $7,200 was saved on a $300 investment—a 2,400 percent return on the money invested!

5—Set up equipment operating records in writing

Establishment of equipment operating records, where they do not exist, is a fifth method of cost reduction. This involves two separate types of records. The first type is the record of cleanout intervals. This, of course, is a question of saving operating and maintenance labor required for solvent-washing, pickling, sand-blasting, and similar operations occasioned by the buildup of sludge, slime and polymeric deposits during operation. Analysis of the causes of these lost-time operations can pay handsome dividends both in increased production and in decreased maintenance labor. The second type of record is the record of equipment replacement. Here a capital expenditure is involved aside from labor costs and lost production, as in the case where a heat exchanger bundle must be retubed.

EXAMPLE—In the manufacture of a rubber-chemical intermediate, careful study of the rate of buildup of hazardous deposits within the equipment resulted in the establishment of a set period between cleanouts. Each cleanout was then carefully planned to insure a minimum of overtime work, to insure that sandblast equipment and other necessary tools were on hand when needed with no costly delays. Estimating down-

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MARSHALL SITTIG *is a chemical engineer with wide experience in chemical and processing plants. He has had about ten years experience in cost reduction work.*

time for this unit at $70 per hr., a saving of $1,000 was made on each cleanout, saving $12,000 per year.

6—Plot operating data graphically to spot unknown correlations in processes

A sixth tool for the cost reduction engineer is graphical presentation of operating data. This sounds so simple that it might be assumed that everyone knows all about it and is using it in every way possible. Such is not the case in many plants. Production supervision can, all too easily, look at a column of figures and fail to see even a trend, much less a cyclic variation in raw material consumption with raw water temperature, for example. A book of graph sheets giving consumption figures and major operating variables by week and plotted on the same horizontal time scale can point out trends and variations.

EXAMPLE—A correlation between the combined SO_2 content of the cooking acid in a sulphate process plant and the amount of makeup sulphur burned was pointed out to operations men as a result of graphical interpretation of data. It was shown that a saving of 25 lb. of sulphur per ton of pulp was possible. Assuming 1,000 tons of monthly pulp production, this is a saving of $3,000 per year.

7—Eliminate wasteful sampling by control units

A critical examination of sampling techniques presents a seventh approach to lower production costs. The size of samples is a little-considered waste. The plant laboratory may possibly be taking a pint sample three times a day, analyzing 10 cc. and pouring the rest down the drain. This gives a waste figure approaching a half a ton every year for this single process sample. It is the composite of many such economies, each seemingly negligible in itself, that makes the difference between poor and good cost performance.

EXAMPLE—A specific example can be cited of the sampling of a high-priced metal salt catalyst in a hydrocarbon polymerization reaction. Here, as described above, a half-ton a year was being wasted. At a material cost of 50 c. per lb., this item represents $500 per year.

8—Consider making solutions more concentrated

An eighth approach to savings is through the medium of increased solution concentrations. This is applicable to the conveyance of fluids in trucks, barges and tank cars. Often the same tank volume may accommodate enough extra pounds by a slight increase in solution concentration to make possible the elimination of an occasional trip with resultant savings in labor and in wear and tear on transportation equipment. Similarly, storage equipment can do extra duty if pumping equipment will permit.

EXAMPLE—A classical example of savings resulting from increased solution concentrations is the use of strohg cooking acid in the manufacture of Sulphite pulp. Some recent figures on a Russian pulp mill indicate that an increase in total SO_2 content of the cooking acid from 5.0 to 7.6 percent effected a saving of 60 lb. of pyrites per ton of pulp, 40 lb. of limestone, 9 lb. of chlorine, plus savings in heat, water, and in increased output from the same equipment volume.

9—Recheck past employee suggestions

Approach number nine to lowered costs involves rechecking of past employee ideas. This is closely allied to the third approach suggested above—that of re-examination of operating standards. This ninth item involves a re-evaluation of employee suggestion box items—perhaps discarded in past periods when maximum economy was not the watchword. It involves a critical evaluation of mechanical job orders by the cost reduction engineer.

EXAMPLE—A piece of drying equipment was plagued by intermittent operation. No investigation was made of the true cause of the down-time but it was simply blamed on the fact that the feed was of different quality than that fed to similar machines which ran smoothly. Investigation revealed that three years previously an order had been put in to change some corroded press rolls. Replacement of these rolls made operation virtually trouble-free.

10—Make a time study of plant operators

A tenth approach to lower costs, perhaps the most fruitful, is also the most distasteful to many chemical engineers. That is the time study of plant operators to see whether they are doing eight hours work for eight hours pay. Cost reduction through chemical control requires constant vigilance but once six men are doing the work that seven formerly did, the chances are that they will continue to do so and one man's wages are clearly and definitely saved. The comparison of operating standards, the second technique outlined above, may be applicable here if data on man hours per ton for a comparable operation are available.

EXAMPLE—Comparison of operating crews in two plants making similar products revealed that, for example, three operators plus three helpers were getting out less production than three operators alone in the other plant. Here this simple comparison permitted a definite and continuing saving of $10,000 per year.

11—Get maximum work from all research and pilot plant equipment

Economy in research may be listed as technique number eleven. Overall research budgets have always been subjected to careful scrutiny but a breakdown of research expenditures has rarely gotten the "going over" that plant operating costs have. Research is more or less of an intangible compared to the realities of manufacturing. Today, however, standardized components of pilot plant equipment, minimization of pilot plant expenditures by maximum application of reaction kinetics to bench-scale data, etc. have done much to lower research costs.

EXAMPLE—An example may be quoted of published results of industrial research on an improved metal casting process wherein a research investment of $3,600 produced cost savings in excess of $26,000 in a single year.

12—Improve safety practices to cut down losses

Savings through safety education represent the twelfth technique for economy in industry. Effort expended on industrial safety pays dividends: the efforts of the Atomic Energy Commission and of Du Pont will show. Lost time due to accidents averaged 1.44 (time-losing injuries per million man hours worked) in all Du Pont plants during the war years and was less than 3.0 in all manufacturing operations of the Atomic Energy Commission in 1949. Both of these organizations have been outstanding for their emphasis on safe practices.

EXAMPLE—The Seventh Semian-

nual Report of the Atomic Energy Commission cites loss ratio figures in cents per $100 worth of property. Atomic Energy Commission fire losses were 3.2 in 1945 and have steadily decreased to 0.8 in 1948 (as against a 10-year national average for all industry of 15).

13—Prepare loss reports for materials lost in processing

Strict accounting for material losses in processing is a thirteenth road to lowest-cost operation. A loss report which must be turned in to management for all material losses in excess of a certain amount (say $100) represents a powerful deterrent to the practice of "ditching" a bad batch.

EXAMPLE—Loss of a liquid catalyst from a polymerization reactor in a large organic chemicals plant made turning in of such a loss report necessary. Operating supervision then held a meeting at the superintendent's request and substituted a flanged valve, bolted to the reactor, for a screwed valve which had accidentally come unscrewed during dismantling of auxiliary piping and had caused the loss of a reactor-full of catalyst valued at several hundred dollars.

14—Write up modern operating procedures for operators

The fourteenth approach to cost reduction lies in the utilization of written operating procedures. This imposes a burden on the operating supervisor who, with the cooperation of the foremen, must prepare such a "bible." Such a manual, constantly revised to reflect the latest changes in procedure, is invaluable however. The "father-to-son" oral transmission of operating instructions is still practiced in some cases. The aggressive, progressive organizations, however, don't say it—they write it.

EXAMPLE—In the conduct of the cleanouts mentioned in the fifth example above, a detailed operating manual was made up covering the points of inspection. In addition, special sheets were made up for each individual cleanout, reminding the operators of lines which gave evidence of plugging during the month past, and of other items whose omission through forgetfulness would cost money during the coming month in improper operation or in the form of a special, premature cleanout. Written systems resulted in decreasing down time by 20 hours at a saving of $1,400 per month.

Specialists Can Make These Tips Work

The regular line organization of production supervision is often so pressed with run-of-the-mill production problems that its members simply cannot take time to assume a proper perspective of the cost problem. Thus, a separate team must be assigned to the job. Two fundamental questions are raised (1) where to get the men and (2) what backgrounds they should possess.

PICK A TEAM

The primary choice involved in picking the source of this team are (1) outside management consultants or (2) men from within the organization. The size of the organization may eliminate the choice —a small organization having no alternative but to go outside the organization. Where a choice exists, each alternative has some points in its favor. The tag of "efficiency experts" (spoken with the same inflection used for "damyankees") is particularly quick to be applied to outside men, but the relatively impersonal nature of such people has its advantages. People picked from within the organization may be able to capitalize upon prior acquaintances but they may equally well alienate these acquaintances on the new assignment. This problem is solved in a large organization by a transfer to another plant. A small organization might do well to hire outside help.

TWO CHOICES

The desired background of the engineers assigned to the job presents another problem. Assume that we are going to overhaul the operations of a tannery. On one hand we might favor a man or group of men who have familiarity with all types of leathers, tanning agents, and tanning techniques. On the other hand, some favor the "fresh" approach wherein one or more individuals with a sound engineering background but no specific background in (and hence no preconceived notions about) the particular operation to be studied. The optimum would be a man or men open to suggestion and eager to apply new concepts but with some knowledge of the industry as a whole to provide some bench marks of performance as a guide.

WORKING TOOLS

Cost reduction teams must have management backing. This must consist of sincere understanding and endorsement on the part of top management—not merely lip service in an effort to salve their own consciences.

The cost reduction teams also must be equipped with supervisory cooperation. This has a dual source. Naturally, the fair and honest conduct of the investigators will go far to build up this attitude in supervision. However, some department heads may be resentful of intrusion and appear deaf to overtures on the part of the teams. Here, management backing should act to give these men a chance to present their case and to have it fairly evaluated.

The third item which must be provided for the investigators by management is access to all cost, production, and labor records of the organization. This gives these men more information than many executives would care to have divulged but maximum results can be obtained only by complete frankness.

PROBLEMS ENCOUNTERED

Cost reduction is far from an easy job, aside from the technical problems encountered. It embodies elements which can lead to friction with virtually everybody in an organization. As an associate once put it, "It's a combination of the United Nations and the FBI."

Management may resent exposures of wasteful practices which have been permitted to exist under their very noses for years.

The workers will resent the presence of the "efficiency experts" mainly because of fear of losing their jobs.

A problem in those organizations which are not basically engineering-minded is getting the story across to members of the executive staff. Skillful report writing with graphic illustrations of problems and proposed solutions are needed here. In spite of such aids, this is a stony road to travel.

THE FLUOROCARBONS

Everybody talks about the fluorocarbons but hardly anyone has had a chance to do anything about them. To find out why we can't get them, when we will get them, what they will be good for—*Chemical Engineering* has gone to a pioneer in the field. He tells here, concisely, what the fuss is all about.

J. H. SIMONS
Fluorine Laboratories
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Questions are currently being asked by many people about the utility of fluorocarbons and their derivatives. What are the fluorocarbons good for? When will they be available? How much will they cost? Most frequently the questions center upon the availability of a particular fluorocarbon for a particular application. These are proper questions, but they are more easily asked than answered. The fact is that only a few compounds of the enormous fluorocarbon domain have yet been made, the important methods of synthesis are yet to be discovered, costs are high, there is no pool of trained researchers, there is not enough money for fundamental research. Does that mean we should turn away in disgust? Not at all. It will take time, but good things are in the wood. Let us see as best we can what these good things may be.

As our starting point for a trip to the future we shall take our present knowledge about the properties of the fluorocarbons. From their properties we can tell fairly well what to expect of them. Both the physical and chemical properties will need to be considered, and we wish to consider these for the fluorocarbons proper, fluorocarbons containing functional groups, and for molecules of carbonaceous structures containing fluorocarbon radicals.

Chemically stable to 500 C.

The fluorocarbons themselves are highly resistant to chemical attack and are thermally very stable. Carbon tetrafluoride is thermally stable up to about 1,100 deg. C., begins to have a detectable rate of reaction with water only at about 850 deg. C., and reacts with the alkali metals only at temperatures in the neighborhood of 400 deg. C. and above. Fluorocarbons containing carbon bonds are less resistant than this to chemical action, because they tend to react by rupture of the carbon-carbon bond. But even these reactions usually occur only at about 550 deg. C. There are two reasons for this low reactivity, thermodynamic stability and low rate of reaction. The latter is due to the compactness of structure which insures a low rate for even those reactions that are thermodynamically highly favored. To compare the fluorocarbons with the hydrocarbons we see that the hydrocarbons have a permanency at room temperature despite the fact that most of them are thermodynamically unstable in regard to their elements or simpler hydrocarbons. This permanency is provided only by a relatively high energy of activation. Under conditions of lower energy of activation, i.e., providing suitable cracking catalysts, detectable decomposition is observed readily at room temperature. With the fluorocarbons the thermodynamic situation is much more favorable for stability of the molecule, so that stability at room temperature would be expected even with a low energy of activation. However, the compactness of structures provides the fluorocarbons with even a higher energy of activation for most reactions than is observed in most hydrocarbons. We can, therefore, expect fluorocarbons to resist most chemical action up to about 500 deg. C. This situation is true for most reactants regardless of whether they are oxidizing or reducing agents or whether they are acidic or basic.

Radicals hew to the line

This resistance to chemical attack by the fluorocarbons is preserved by fluorocarbon radicals, when these are attached to functional groups or to molecules that are not otherwise fluorocarbon. In some cases the carbon atom adjacent to the nonfluorocarbon part of the molecule is more reactive than the remainder of the radical and, in certain reactions, is subject to the loss of fluorine atoms. In general, however, the fluorocarbon radical on a molecule is quite resistant to attack. Compare, for example, the ease of hydrolysis of benzotrichloride with the resistance to hydrolysis of benzotrifluoride. The methforyl radical on the benzene ring also provides resistance to oxidation of the ring. The oxidation of benzotrifluoride is accomplished only with extreme difficulty. This particular property has been beneficially employed in certain dyestuffs. A considerable amount of fading of dye is caused by photochemical oxidation. Methforyl groups in this type of dye molecule provide resistance to oxidation and increases dye fastness. If this property is a general one, and it appears to be, then the inclusion of a fluorocarbon radical in a molecule will provide a group which is both highly resistant to reaction and also increases the resistance to reaction of the entire molecule. The work in this direction promises significant progress.

Don't judge by analogs

In molecules of fluorocarbon derivatives, i.e., molecules that are essentially fluorocarbon but contain functional or nonfunctional groupings of atoms other than carbon and fluorine, the properties are considerably different from the analogs of these compounds in organic chemistry. For example, the fluorocarbon carboxylic acids are very much more strongly acidic than the corresponding organic acids. Physical properties also show considerable difference. For example, the dielectric constant of trifluoroacetic acid is very much higher than acetic acid, some five times; and it exhibits the very unusual property of increasing with temperature over a very considerable temperature range. A molecule consisting of two fluorocarbon radicals attached to an oxygen atom, i.e., a fluorocarbon oxide, exhibits none of the properties characteristic to the analogous organic compound, an aliphatic ether. It shows none of the characteristics of solubility. It is neither a good solvent for acidic substances, nor is it split by the usual techniques available for the splitting of organic ethers. In the same way the fluorocarbon nitrides (compounds in which three fluorocarbon radicals are attached to a nitrogen atom) exhibit none of the characteristic properties of aliphatic triamines. For example they show no basic characteristics. Hydroxy fluorocarbons, which would be analogous to alcohols, have not as yet been prepared, although attempts have been made to do so. This probably indicates a relatively low stability due to a tendency for the splitting of hydrogen fluoride. Compounds in which the hydroxy group is insulated from the fluorocarbon radical by a CH_2 group have been made and show much higher acidity than the corresponding organic alcohol. A fluoroxy compound has been made, however, the analog of which is not possible among organic compounds.

Beware false data

Because of the stress of wartime conditions under which a considerable amount of the now obtainable information was secured and also because of the fact that new methods of preparation and purifications are required, some of the chemical data now available relative to fluorocarbons is misleading. A considerable part of this is due to minor impurities in the fluorocarbons. The fluorocarbons are so much more resistant to chemical action than most impurities that these give chemical characteristics to the mixture which are quite different from those of pure fluorocarbons. Let us suppose we have a sample of material which was purported to be C_8F_{18}. If the bottle contained $C_8F_{17}H$, the hydrogen content would be slightly less than 0.25 percent. If the material, however, were 99 percent C_8F_{18} and 1 percent $C_8F_{17}H$, the hydrogen percentage would be slightly less than 0.0025 percent. Although this would be extremely difficult to detect by analysis, it would impart considerably different properties to the mixture. If, for example, this fluorocarbon hydride were more readily hydrolyzable than the fluorocarbon itself, ordinary tests of hydrolysis would give a rather appreciable indication of reaction, for once hydrolysis on such a molecule began it would probably proceed down the carbon chain until all the fluorine of that particular molecule was converted to fluoride ion. Recently improved methods of purification enable much purer samples to be obtained, and recent work in both chemical analysis and spectrum analysis enable the purity to be estimated with greater accuracy. Earlier samples from both industrial and government sources were sufficiently impure to have properties which were misleading. Regrettably such unnecessarily impure samples are still being supplied from some sources. This is retarding the utilization of fluorocarbons by having false information in the hands of the very people who would use the materials if the correct data were available to them.

Physical properties, pleasant surprises

Boiling and freezing points

It is not only for their chemical inertness that fluorocarbons will find employment. The physical properties promise many uses. The fluorocarbons have boiling and freezing points not greatly different from hydrocarbons having the same carbon skeleton. Isomeric fluorocarbons tend to boil very nearly at the same temperature, whereas isomeric hydrocarbons show a considerable range of boiling points. Fluorocarbons with four carbon atoms in the molecule boil very nearly at the same temperature as hydrocarbons with the same number of carbon atoms. Lower boiling fluorocarbons boil higher than the analogous hydrocarbons, and higher boiling ones boil lower than the analogous hydrocarbons. This difference in boiling points increases for analogous compounds with increasing number of carbon atoms such that C_8F_{18} boils about 20 deg. below n-octane. Because of the low boiling points for their molecular weights, the fluorocarbons provide vapors of extremely high density. The above-mentioned compound with a molecular weight of 438 boils at 104 deg. C. Even more surprising, the fluo-

". . . who will pay for it?"

The burden of this exposition is that highly desired utilitarian products appear possible from the fluorocarbon domain. The knowledge in this domain has not advanced to a point where we can with confidence proceed to the commercial aspects of the problems. Much and very costly development work is yet to be initiated. Still more important we need the fundamental new knowledge that can only be obtained from basic and fundamental research. By this latter term I mean that kind of research which the industrial companies and the government laboratories both say does not come within their scope. It is not sufficiently practical; it should be done by the university. In all sincerity I ask, who will pay for it? The industrial companies say the government. The government says the universities. The universities say we're broke and can't; the individual will have to pay for it, if he desires to do it. Under present conditions the individual in the university simply cannot do it. His obligations are too great and his financial resources too small for him to even consider such matters. There are at present many too many government sponsored research projects in the universities, and the research man must engage in these in order to provide funds for the overhead for the institutions.

There is no source of funds in view for progressing in new fields or in new directions. Progress will be made along these lines despite this fact, but it will be slow, very painfully slow. It will come about as in the past by individuals with an urge for science and new knowledge creating the necessary sparks and performing the necessary labors in what otherwise would be time for relaxation. They will also extract a small amount of the necessary facilities and time from their important obligated duties and from the sponsored, directed, and financed programs. In other words, they will bootleg just a little of those things that are available to provide values for society immensely greater than those regulated activities from which they were bootlegged.

—J. H. Simons

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rocarbon oxide, $(C_4F_9)_2O$, molecular weight 454, boils at 101 deg. C.

Refractive indexes The fluorocarbons are very transparent substances having apparently no absorption bonds in the visible. The refractive indexes are generally below 1.3. This property, of course, is subject to variations due to structure and the presence of substituents. It can be used for purposes of identification in the same way that it is used in organic chemistry.

Viscosities The fluorocarbons have viscosities usually not greatly different from hydrocarbons of the same carbon structure. In fact, for most fluorocarbons the viscosity is either higher or lower than the corresponding hydrocarbon depending upon the units of viscosity and the temperature.

Surface tensions A property of the fluorocarbon that is very striking is the extremely low surface tension. Liquid fluorocarbons have surface tension about as low as any known liquid in the same boiling ranges. This property alone may be the reason for the employment of fluorocarbons for a great number of important purposes.

Solubilities An unexpected physical property of the fluorocarbons occurs in the solubility relations between fluorocarbons and hydrocarbons. Two substances of the same boiling point, of the same zero dielectric constant, of practically the same polarizability, and of the same carbon skeleton structures might be expected to be ideally soluble one in the other. A fluorocarbon and a hydrocarbon fitting the above specifications form solutions which are very far from ideal. In fact, the separation into two liquid phases not far below the boiling point can be expected. This particular solubility behavior when considering all compounds in the fluorocarbon domain provides a body of solvents with new properties which may be significant in regard to extraction and similar problems.

The lesser solubility of fluorocarbons for organic substances than equivalent organic solvents, the low solubility for water, and the low surface tension together impart to the fluorocarbons a rather unique situation in regard to adhesion to other substances. Extreme difficulty has been found in obtaining substances that would adhere to solid fluorocarbons. This property would provide to any surface composed of fluorocarbon molecules a unique property of nonstickiness or extreme ease of cleaning.

Compounds compounded

Atoms As fluorocarbons of almost any number of carbon atoms and almost any skeleton structure will probably be forthcoming as well as the host of derivatives in numerous homologous series, it can be expected that gases, liquids, and solids of a host of physical properties can and will be prepared. The mere fact that a particular substance composed of fluorocarbons with a certain desired set of properties is not at present available is no indication that it is impossible of attainment or that given sufficient stimulation it cannot be obtained within a reasonable period of time.

Compounds The number of known chemical compounds in the fluorocarbon domain that have been prepared and identified is being added to daily at such a rapid rate that no reliable estimate of this number can be given. It is probably in the order of magnitude of one thousand as of the time of writing, but that number can be expected to be far outdistanced before this exposition is cold. We can, however, at this time see the outlines of what is to be, and a brief preview may be in order to whet the appetite of the prospective user.

Series Of the compounds of carbon and fluorine alone, i.e., the fluorocarbon proper, we now know of members of many series. Chain compounds have been prepared in significant numbers with the chains either straight or branched and cyclic compounds containing rings of four, five, and six members as well as compounds containing fused rings, rings with side chains, and the like. From this, it can be confidently predicted that all the variety of skeleton structures present in hydrocarbons are possible for fluorocarbons, and due to their greater stability, fluoro-

carbons of skeletons structures not available in hydrocarbons will be forthcoming. Compounds containing less than the number of fluorine atoms required to satisfy the valence demands of the carbon atoms have also been made. Although the name may be misleading, we might call these olefinic or unsaturated fluorocarbons. The lowest member of these substances, the one with only two carbon atoms, shows the characteristic olefinic properties of the addition of bromine, polymerization, and condensation with a variety of substances. As the number of carbon atoms increases, however, these properties decrease rapidly. Although some of the techniques available for reactions of organic unsaturated compounds may be denied us, we hope to invent new and equally useful techniques for fluorocarbons of this kind. Until we do so, however, we may not even be able to characterize such compounds by chemical means, and we will have to rely upon physical determinations for identification.

Reactive and unreactive

Fluorocarbon derivatives are now being made in significant numbers. These occur in two classes: those that are reactive and those that are relatively unreactive. We can mention the fluorocarbon hydrides, chlorides, oxides, and nitrides for characterizing the properties of these latter compounds. Let us consider those containing only one atom in the molecule of the above-mentioned elements. The fluorocarbon hydrides are very nearly as stable and unreactive as the fluorocarbons themselves. For the same carbon skeleton the monohydride boils higher than the fluorocarbon proper and has a higher refractive index, a higher dielectric constant, a tendency to hydrolyze and react with chlorine and bromine much greater than a fluorocarbon. The fluorocarbon monochlorides are not quite as stable and unreactive as the fluorocarbons, but attempts to use the chlorine atom as a point of chemical attack for useful synthesis have so far been unsuccessful. Compounds of this kind show no advantages over the fluorocarbons in any significant properties but have some disadvantages. Fluorocarbon oxides have thermal stabilities that approach those of the fluorocarbons. Higher members of this series have boiling points even lower than fluorocarbons of the same number of carbon atoms despite the higher molecular weight. As they show none of the usual chemical reactions of organic ethers, their uses will probably be very similar to those of fluorocarbons. The fluorocarbon nitrides seem related to the fluorocarbon oxides and approach them in stability. These four relatively inert derivatives provide an opportunity of compounding mixtures with fluorocarbons to provide inert substance having a range of properties.

Functional groups

Fluorocarbon derivatives containing functional groups of considerable reactivity are beginning to be prepared in significant numbers. We can mention fluorocarbon bromides, fluorocarbon iodides, fluorocarbon carboxylic acids, and a fluoroxy fluorocarbon. The properties of these substances have only begun to be studied. Although the Grignard reaction appears possible for some of the fluorocarbon halides, either major modification or drastic change will have to be made in this type of reaction before it can be put to general use. The same statement is probably true for all organic chemical methods, and it seems reasonable that an entirely new set of reactions will eventually be evolved to carry on synthetic chemistry in the fluorocarbon domain.

Radical groups

Organic compounds containing fluorocarbon radicals have been made in fair numbers. With new fluorocarbons containing functional groups being available we can expect this field to expand rapidly. The substances so produced will find employment in places where the extreme properties of the fluorocarbons are not required but only modification of the organic compound. As the organic part of these molecules will still undergo most of the organic chemical reactions with only slight modification, these substances can be put into use more rapidly than the entirely new class of substances in the fluorocarbon domain. Up to the present only the methforyl group has been available for use in organic molecules. Recent work gives promise of providing other fluorocarbon radicals for such uses.

How to make fluorocarbons

New methods

The methods of synthesis of the fluorocarbons and their immediate derivatives are drastically different from those of hydrocarbons. Chronologically, the first method was a reaction between the elements. At first only CF_4 was identified from such a reaction, and explosions almost invariably resulted. Changes in technique and considerable experimental work have shown that large quantities of fluorocarbons can be made by this procedure. There are no obvious reasons why improvement in technique cannot reduce the percentage of CF_4 to ever lower values. At present somewhat less than 35 percent has been achieved. When the fluorocarbons have general employment in all boiling ranges this may be a commercially feasible process, because high boiling condensed ring structures are made by this method that may be extremely difficult to make otherwise; and the process makes more efficient use of fluorine than any other process that employs the free element. The electrochemical process has been sufficiently developed, so that confidence can now be placed in its general utility. High yields of specific substances, either fluorocarbons or fluorocarbon derivatives, can be readily made in one step by this process. This gives us assurance of a ready supply of raw materials in both quantity and variety as rapidly as there is a demand for them. The chemical reaction and synthetic methods of fluorocarbons already known and being currently discovered insure ability to convert the fluorocarbon raw materials produced by the electrochemical process into all the multitudinous finished products that may be required.

How to use fluorocarbons

Not substitutes

Because of the great difference between the members of the fluorocarbon domain and compounds in any other branch of chemistry,

"... analogy, becomes useless."

Lest people become too impatient, it may be well to reflect as to why their particular fluorocarbon plastic or lubricant is not immediately available at their favorite supply house. The very fact that the domain is so extensive is in itself a reason that time will be required. Before many of the intriguing new materials will become available a great amount of fundamental research is necessary. Our needs are new knowledge, new methods of synthesis, and new theoretical points of view. One of the primary reasons for slowness is the fact that there has not been enough time to train the many people needed to carry on this research. It may be argued that we train many chemists—why can't they do this work as well as anything else? Perhaps they should, but the results of experience show otherwise. Organic chemists are people trained with the points of view and the methods useful in organic chemistry. And it can be shown that the properties of substances, the methods of synthesis, and the theoretical framework of the fluorocarbon domain are significantly different from the domain of organic chemistry. A chemist uses analogy in his thinking processes—a useful tool when confined to one domain. But analogy becomes useless and a positive bar to good thinking when it is used to extrapolate from one domain to another. —J. H. Simons

it is harmful to consider the fluorocarbons as replacements or substitutes for other substances. They are new compounds with new properties for new uses, and it is important that we carefully consider the desirable properties of the substances in relation to the particular situations in which those properties may be beneficial. A few examples may be helpful. Low boiling fluorocarbons would naturally be considered for refrigeration purposes. Their detailed engineering thermodynamic properties will not be identical with presently used refrigerants so that they would not improve operating efficiencies by a one-to-one replacement in equipment designed for present refrigerants. If the fluorocarbons were to be used, optimum operating efficiency could only be had by a design based upon the thermodynamic properties of the particular fluorocarbons. Again the fluorocarbons may not be replaceable for this other refrigerant on a cost basis. The particular properties of the fluorocarbons—very high resistance to chemical action, complete lack of toxicity, resistance to destruction in a flame and when they are destroyed in a flame, the issuance of no highly toxic products—might be sufficient for certain applications to greatly counterbalance a cost differential.

Oxide, not ether

To show how we may be misled about the properties of fluorocarbons, assume we are employing an aliphatic ether for a certain important purpose. The high combustibility and low flash point of this material impose undesired hazards. The thought immediately arises that a fluorocarbon ether would be just the thing for this place, and the increased cost would be compensated by lower insurance rates. The word ether to the chemist denotes certain important chemical and physical properties and when a certain fluorocarbon is called an ether, he rightly expects the material to act like one. Fluorocarbon compounds containing the same skelton structures as the aliphatic ether have unfortunately been called ethers despite the fact that they possess none of the properties which are usually considered by the chemist as characteristic of ethers. I would prefer to call such compounds fluorocarbon oxides so as not to mislead. If the usual ether properties are desired, it will be necessary to have one or more organic carbon atoms adjacent to the oxygen atom in the molecule. Such a compound may be useful for this desired purpose—the fluorocarbon radicals reducing the danger of combustion and explosion, but the organic part providing the ethereal properties. A similar situation has also developed in the regrettable naming of nitrogen containing fluorocarbons as amines. I refer here to what I choose to call fluorocarbon nitrides, i.e., compounds in which the nitrogen atom is attached to three fluorocarbon radicals. The properties of these compounds would lead one to expect them to be derivatives of nitrogen trifluoride rather than ammonia. Calling them amines leads one to expect basic properties which they do not possess. If the properties of an organic base are desired while at the same time providing some of the desirable properties of fluorocarbons, then a similar situation results as explained above in regard to ethers.

Nitride, not amine

Paint? Fabrics? Solvents? Not now but someday

Picture a type

Another way of considering the possible uses of fluorocarbons would be to picture a type of substance that would be useful, if to it could be imparted certain of the properties of the fluorocarbons. A good example of this is paint, varnish, or enamel. Let us call such a material a fluorocarbon paint despite the fact the name may be actually inappropriate. From the properties of the fluorocarbons we would imagine a fluorocarbon paint to have these very desirable properties. It would be noncombustible and would greatly reduce the hazards of fire even when used on otherwise combustible materials such as wood. Due to the lack of adhesion of fluorocarbons to other substances, it would be extremely easy to clean. It would not undergo slow oxidation or deterioration due to light, insects, mold, or similar destructive agents. It would tend to preserve its color in a light fast condition. We can all agree that such properties are highly to be desired and may even be willing to admit that such a material would be worth a considerably higher price.

At first glance one would say that all one needed would be a fluorocarbon resin to put into the formula of some presently available varnish. Would that it were this easy. What resin, where, and how to make it—from what. No fluorocarbon resin yet produced has the desired properties. Even if we had a resin, it is highly questionable that it would be compatible with pres-

ently used solvents and thinners. When a fluorocarbon resin is obtained, it will be necessary to make it adhere to the underlying surface but still have little adhesion for anything else. I merely cite this to show that substitution or replacement is not the path to follow. Do the questions just raised mean that the desired cannot be had? Indeed not.

Procedure

One could outline the procedure of obtaining a fluorocarbon paint somewhat like this. We shall simultaneously need to develop the resins, the fillers, the pigments, the solvents, and the thinner. Each and everyone of them will need to be synthesized with a view to their particular properties and in relation to their cooperative employment with the other necessary ingredients. It would certainly be insulting to the abilities of chemists to affirm that this could not be done, and I believe that most people would agree that the ultimate value of a fluorocarbon paint would be worth the effort. Those of us with the longest experience with the fluorocarbons know full well that the basic chemistry is now unfolding that will enable all this and more to be done.

Let us take another example. Would fluorocarbon fabrics be desirable? The answer is an unqualified yes. Are they within the realm of possibility? The answer again is yes. Are they available? Regrettably no. What is needed for their attainment? That is the only easy answer—money and patience.

There is one area of use in which the fluorocarbons can possibly find employment most quickly. This is for use as solvents and also as liquid phase medium in which to carry out chemical reactions. The desirability of having a liquid phase medium of carrying out reactions is well understood. For reactions, such as energetic oxidations, sufficiently resistant liquids are not readily available. After a sufficient amount of study is made on the solvent properties of fluorocarbons and their derivatives in all their multitudinous variations, fluorocarbon liquids can probably be provided that will help the chemical processing industry tremendously.

The fuss about fluorocarbon lubricants

Low adhesion and cohesion

An intriguing possibility for the use of fluorocarbons is for lubricants. The fact that adhesion and cohesion are both very low would indicate good lubricating properties. The resistance to both thermal decomposition and chemical reaction would give promise of providing lubricants to withstand higher temperatures than present lubricants. The fact that a reaction analogous to the dehydrogenation reaction of hydrocarbons is not available to fluorocarbons would remove one of the major difficulties experienced with hydrocarbons, i.e., the tendency to form unsaturated compounds which subsequently polymerize to form gums. The resistance to oxidation reduces the tendency to form acidic substances that result in corrosion. Tests of fluorocarbon liquid mixtures of high boiling components have shown promise of lubrication properties. These facts would indicate that fluorocarbons could be used in machines of current design, sometimes with considerably beneficial results. For example, in addition to the above-mentioned possible advantages, a fluorocarbon liquid lubricant might be advantageous for use in internal combustion engines using hydrocarbon fuels, because of the fact that the solubility of hydrocarbons in the fluorocarbon lubricants is much less than it is in an analogous hydrocarbon lubricant.

Intriguing possibility

The most significant factor governing the use of fluorocarbons as lubricants is, however, not in the replacement of some other lubricants in a machine of current design. The intriguing possibility of fluorocarbon lubricants lies in the possibility of designing new and improved equipment taking advantage of the particular beneficial properties of the fluorocarbons. We can immediately see the possibility of the use of higher temperatures. Higher engine efficiency and economy might result. Because of the resistance to oxidation, not only is fire hazard reduced because of the combustibility of the lubricants, but also the lubricant can be used in the presence of highly oxidizing gases such as oxygen and chlorine. Air compressors, for example, need to be carefully designed so as to prohibit explosions due to combustion of the oil. Multistage compressors are employed because a low compression ratio in any one stage is necessary in order to overcome this difficulty. Fluorocarbon lubricants in such a case might have significant advantages. Again I will have to admit that special lubricants for a host of new uses, made entirely of fluorocarbons, are completely unobtainable. Our knowledge has simply not advanced to the point where we are able to produce them. One must realize that hydrocarbon lubricants, in the first place, came from very simple distillations of crude petroleum. From that point to present technology of lubricants required many years and the work of many men. For fluorocarbons we do not even have the analog of crude petroleum from which to start. Lubricants in general are complex mixtures and are not single chemical species. We are not even satisfied that we can specify the detailed hydrocarbons and their specific concentrations in the ideal hydrocarbon lubricants. Realizing that analogy between hydrocarbons and fluorocarbons is not good reasoning, it should be realized that our knowledge as to what fluorocarbons to employ and what concentrations thereof is infinitesimal. Even should that knowledge be available, the individual fluorocarbons would have to be made. That may take more than a few days.

Violent birth

Some samples of fluorocarbon lubricants have been made by subjecting a hydrocarbon lubricant to the violent hydrogen replacement reactions employing certain metallic fluorides (CoF_3 and AgF_2). In the first place, the violence of these reactions would necessarily produce a fluorocarbon mixture whose molecules were not identical in carbon skeletons to those of the hydrocarbon mixture. In the second place, it is purely fortuitous that a fluorocarbon mixture produced in this way would have any desirable lubricating properties at all, even though the structures were identical and in the same concentration as the hydrocarbon mixture.

Even though such a mixture were not a good lubricant, there would be no indication whatsoever that a proper fluorocarbon mixture would not be an extremely valuable lubricant.

Viscosity index

It has been said that fluorocarbon lubricants would not be useful because their viscosity index is not as favorable as the best presently made hydrocarbon lubricants. This is an extremely erroneous point of view. In the first place, is is comparing a chance mixture of fluorocarbons with a highly developed hydrocarbon lubricant. In the second place, it is inferring that the same machine will be used with the same viscosity requirements. The change of the viscosity with temperatures of pure substances is usually high. Lower viscosity change with temperature is provided by making liquid mixtures of many compounds. It is highly probable, therefore, that fluorocarbon mixtures can be prepared with highly favorable viscosity indexes. It is true, as some people have pointed out, that a certain fluorocarbon of the same carbon skeleton as a hydrocarbon has a greater change of viscosity with temperature. Two things can be said in reply to this. In the first place for some of the very compounds given as examples of the above the opposite is true when taken in a different temperature range. Other fluorocarbons can quite conceivably have a temperature coefficient even less than that of the analogous hydrocarbon in all temperature ranges. Even though this were not the case, until we have exhaustive systematic study we should not make any generalizations in regard to substances not yet prepared. For the machine not yet designed to use fluorocarbon lubricants, how can it be asserted what temperature coefficient of viscosity may be demanded?

Bearing design

There are a variety of situations in which lubricants are used, and the lubricant actually performs more functions then merely providing a surface of low friction. Sometimes a flowing liquid lubricant is used, sometimes a nonflowing liquid or grease is used; and in some cases a low friction bearing is provided without the presence of a liquid at all. The flowing liquid lubricant can provide continuous cleaning of the bearing surface and act as a cooling device for the bearing. In many types of bearings merely replacement of the lubricant is required. In small machines flowing lubricants are seldom necessary, as the design provides sufficient metal to conduct the heat away from the bearing surface. It would seem possible for this kind of lubrication to provide solid fluorocarbon bearings provided, of course, that proper ones could be made. It would appear that the lack of adhesion to a solid fluorocarbon might enable this to be possible. In this case, viscosity index is of no significance. Even for larger bearings, this type of construction might be considered by incorporating a cooling device in the design. Whether or not friction could be adequately reduced in this manner is pure speculation. It would also seem difficult to provide a solid low-friction surface for roller and ball bearings in the present state of development, but even this might be possible. In regard to the beneficial use of a flowing liquid lubricant for the purpose of keeping the bearing surface clean, we can state that it is conceivable that the fluorocarbon lubricant would avoid this necessity. The foreign material that needs to be removed from the surface is either metallic particles abraded from the bearing surface or particles of decomposition of the oil itself, some of which is caused by the catalytic action of the metal on the hydrocarbon. As one can readily perceive, both of these might conceivably be reduced by the use of fluorocarbon lubricants. If the lubricant itself is not destroyed, in the bearing, its replacement is not so urgent.

Flight without fire

Light and combustible

One of the not inconsiderable hazards of aviation is the ever present possibility of fire and explosion. Most airplanes are mechanical devices of relatively light construction covered for the most part with some combustible surface treatment such as paint or varnish. Highly combustible rubber is used for tires and other purposes such as the leading edges of wings. Lubricating oil is circulated through the engines to various bearing surfaces, from which it may be splashed to other parts of the machine. Liquid hydrocarbons are also used in many planes in the hydraulic system to provide the transmission of power to many parts, and this means that tubing carrying a highly combustible liquid is present in many areas of the airplane. A combustible liquid is also transported to and ejected from the propeller for deicing purposes. In addition to this the hydrocarbon fuel is highly volatile and has a low flash point. It burns vigorously and on admixture with air can provide for explosions. It probably is not surprising, therefore, that fire and explosions are a considerable hazard in aviation. In view of this, perhaps the NO SMOKING signs have greater significance. It is not necessary, however, that the spark be provided from tobacco. The internal combustion engine has incorporated in it an electrical device, designed particularly to provide sparks for the ignition of the hydrocarbon fuel, and sparks are difficult to avoid on collisions. If we allow our imagination full play, we can dream up an airplane in which fluorocarbons will very greatly reduce these fire hazards.

Light and non-combustible

Our imaginary airplane will have no combustible materials in its construction. No wood or combustible plastics will be used—instead, where such types of materials are desired, fluorocarbon plastics as yet not created will be employed. We can have confidence that plastics of all types of physical properties can and will be made from fluorocarbons. Instead of rubber for the tires and for the leading edges of the wings, fluorocarbon elastomers will be used. It has already been demonstrated that fluorocarbon elastomers are possible, but a great deal of further research will be needed in order to get them in a convenient price range. Where fabrics are desired, combustible ones will be replaced with either glass or as yet undeveloped fluorocarbons. Fluorocarbon liquids will replace oil in the hydraulic system. This is one place where our present knowledge insures us that

only a little further development work is necessary in order to provide the proper material. It is true that perhaps it may be necessary to make some changes in the mechanical equipment, but at present these appear to be only minor modifications.

Propellers In all probability the propeller will have either a fluorocarbon surface of some kind or will have fluorocarbons provided in some way to serve for deicing purposes. The fluorocarbons' low compatibility for water would indicate that they would be superior materials for such purposes. The added advantage of lack of combustibility makes their investigation for such purposes most impelling.

Paints Where surface coatings are required it appears obvious that the above-mentioned fluorocarbon paint would be specified. Even if a combustible oil were accidentally splashed on such a surface, it would not be absorbed and would be easily removed.

Carburetors While on the subject of deicing, it might be well to suggest that where gasoline engines are used a fluorocarbon insert in the throat of the carburetor might be a suggestion of considerable interest, due to the high probability of lessening the danger of ice formation at that point.

Lubricants Naturally the lubricant will be made of fluorocarbons. This will greatly reduce the possibility of fire not only because of the removal of the hazard of the fire taking place at the bearing itself, but also from the coating of lubricant that occurs in the neighborhood of the bearings and which, when hydrocarbon lubricants are used, provides a highly combustible material everywhere within the vicinity of moving parts.

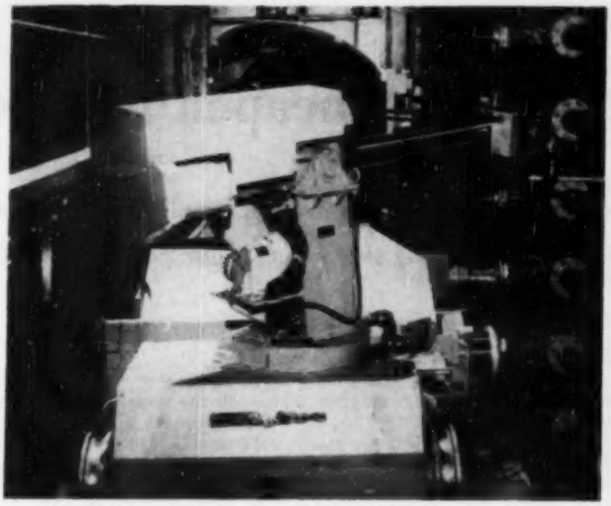
Fuels Perhaps even the engine could be modified. If our point of view is the reduction of fire hazards, gasoline should be eliminated; a fuel having lower volatility and lower flash point should be used to reduce the probability of fire. Advantage might also be had in eliminating the high potential electrical circuits, which are necessary in the gasoline engine to provide the spark for ignition. With apologies to the courteous reader I should like to dream up an engine for the airplane to reduce these conditions of hazard. I realize full well that the details may not be forthcoming, and even with very considerable effort the final result may not be satisfactory or might not even be possible. But how can we be assured unless first we have a dream.

Engines Reciprocating engines have certain disadvantages as all engineers know. Turbines are advantageous in certain respects. The steam turbine is highly developed and is useful for many purposes. If it were possible to reduce both the weight of the engine and the weight of the fuel necessary for operating a vapor turbine, then this type of construction might be considered for the power plant of our airplane. Mentioned earlier was the fact that the compound $(C_4F_9)_2O$ with a boiling point only 1 deg. C. higher than water had a molecular weight in the vapor of twenty-five times that of water. This material, therefore, at the same temperature and pressure of the vapor has a density about twenty-five times that of steam. For use in a vapor turbine this would greatly reduce the size of the necessary engine. It correspondingly reduces the size of the necessary boiler. Of course with fluorocarbons we are not limited to a material with a boiling point the same as water. Any boiling point within certain limits that we desire can be provided by members of the fluorocarbon domain. It is well recognized that higher temperatures of the source of our heat engine provide higher thermodynamic efficiencies. Up to the point where the fluorocarbons would become corrosive for metallic parts, which is far above the boiling point of water, we could operate the fluorocarbon turbine.

Fuels Higher boiling fluorocarbons also have higher vapor densities. This might enable us to use as a fuel an oil with a much lower flash point and volatility than gasoline. Such a heat engine requires, of course, no electrical spark for ignition, although such could or could not be provided depending upon circumstances. If such an engine were within the range of possibilities, and we should not casually dismiss it as impractical without serious consideration, then it might be possible to eliminate one of the most serious fire hazards of our airplane. The fluorocarbon used as the turbine impellent can even be employed to serve as a fire extinguisher should a fire begin.

If this dreamed-up airplane with greatly reduced fire hazards is offensive to the reader, please excuse. If some of the things are highly desired but considerable human effort is required for their accomplishment and funds are not provided for the very fundamental scientific work necessary, please don't lay the blame on the scientist and engineer. If the ideas themselves are considered as visionary, please realize that all desirable things are visionary until they become reality. It is hardly fair to condemn all visions, because some or even many have not yet been realized. We should rather appreciate that some visions have been the primary cause and motive for most of those things which we most highly value. There is just one question that I should like to put. Provided the above dreams could be accomplished, would you not "take a trip in my flying machine."

What's it worth to you? How long will it take to achieve many of the useful results that appear eventually to come from the fluorocarbon domain? This depends upon many human factors. In the first place, same results may be fairly easy to achieve; others will take considerably longer. The first materials should be commercially available within a year or two. New materials should be regularly added to our supply sources for hundreds of years. The particular time necessary for any one particular thing will depend upon the amount of effort that is spent on that thing. This amount of effort will depend in a large measure on either the money that is available for that particular thing or the whim of those either doing the work or supplying the funds. Many of the more important things can be obtained in a relatively short time—say five years—if we desire them sufficiently and are willing to spend sufficient effort. To the questioner that is interested in how long will it take before I can get such and such a material, the companion question must be put. What are you willing to provide, so that the material you desire can be available?



New Robot for Hanford

General Electric Co. has designed and built a five-ton "tool dolly" on wheels, which will be used in unsafe radioactive areas at the Hanford Works plutonium plant in eastern Washington.

This one-armed "robot" can open and close doors, turn valves and take apart and reassemble complex machinery. It consists of a deck with a telescoping arm, on the end of which are double clamps. The arm can be extended, shortened, raised or lowered by remote control. The "hand" is capable of a wrist-bending motion, rotation and gripping.

The dolly also is equipped with a hydraulic ram, electrically controlled, with 4-ton pushing force, rotating devices for opening and closing valves and several specialized attachments. It rolls along narrow-gage railroad tracks under its own power. Six cables link it with the remote controls from an adjacent shielded room. A 3-ft. mirror, also remotely controlled, allows the operator to see what the device is doing.

Valve-turning attachments are equipped with electric "feelers" which indicate whether the valve handle is properly centered in the grasp of the turner. All in all, the dolly has 24 electric motors, 6 of them in the arm and hand.

Control panels equipped with lights indicate the position of the dolly's tools with respect to the apparatus being worked upon when it is impossible for the operator to watch the work through the mirror.

General Electric engineers say a man can be trained to operate the dolly in a week and that persons with no previous experience at manipulating the hand have been able, after a few tries, to pick up a dime.

What About Unit Operations Costs?

Editorial Staff

An important part of the duties of many chemical engineers and chemical engineering executives is the estimation of processing costs and the cost of projected products. Yet this is a time consuming task requiring a lot of experience and it often produces discouraging results, either when the data are turned over to the company's cost accountants for further processing or, lacking that check, when it proves to be faulty in actual production.

We are indebted to Robert M. Boehm, director of research for the Masonite Corp., at Laurel, Miss., for the suggestion that it may be possible to develop a system for the preliminary estimation of unit operations costs which could do for operating cost estimation what our long series of equipment-cost articles has done since 1947 for equipment cost estimation.

In the equipment cost articles there was no suggestion that highly accurate estimates could be prepared without accurate, detailed and up-to-the-minute figures, but the methods put forth have made it possible in many cases to deal with preliminary estimates satisfactorily, and in a small fraction of the time normally required. Presumably, if some method of establishing standardized unit operations costs could be developed, it too would be limited in accuracy to use in preliminary estimation, but again it should be a great time saver in the earlier stages of process development when feasibility is being investigated, or the profit possibilities of several different processes are being compared.

As Mr. Boehm puts it, "Raw materials costs, utilities, yields and the like are basic costs of the operation and are largely, although not completely, independent of volume of production, changing labor costs, freight rates, and so on. But these basic costs are only a part, and often a minor part, of the finished cost of the product. Amortization, depreciation, obsolescence, maintenance charges, operating labor, factory overhead, and other factors that cost men reserve to blight the dreams of research men, also have a terrific influence on the final result. Here is where long experience seems to count most, and where the most difficult part of the estimating job resides.

"My guess is that 80-90 percent of any manufacturing problem met in process industries can be broken down into the better known chemical engineering unit operations. With some simple method of calculating the costs of these unit operations, preparing the overall estimate would be greatly simplified, leaving perhaps only 10 percent of the problem for individual study."

So far, neither Mr. Boehm nor the editors know how such a study should proceed, nor in fact whether it is feasible. That is why we throw it open for discussion. We earnestly invite the correspondence of all readers who have suggestions, pro or con, on any phase of the subject.

A Cheaper Way to

Use specifications if you are going to order a small plant. You can assemble them easily using this plan. Your purchase will be

DONALD Q. KERN

More than half of the inquiries received by our process engineering division for medium size and small chemical plants are unaccompanied by specifications of any kind. An informal check with other contractors engaged in the design and construction of this class of chemical plant showed that the procedure is fairly prevalent on many projects running into several hundred thousand dollars.

In some cases where a chemical processor has no design engineering staff of his own the omission of specifications arises from the feeling that arbitrary specifications might increase the initial plant cost. And by sending his inquiries to several contract engineering firms it is believed that competition itself will establish the optimum design conditions. Actually, proposals which are prepared without specifications usually establish a plant of low initial cost. But this is by no means the most desirable characteristic in plant design nor does it favor the building of an efficient plant. The problem of providing specifications in sufficient detail to provide a plant reflecting the purchaser's wishes can be prepared in a short time with a minimum of technical personnel.

Specifications serve a very definite purpose. They are the means by which a processor can express his own preferences, experiences and expectations in detail. Moreover, well drawn specifications establish a comparative basis by which a processor can determine which contractor offers the most plant for the money. This is the truer index of value rather than the plant which can be assembled at the lowest cost. Buying at the lowest cost against good specifications is a prudent investment. Buying at the lowest cost without specifications frequently leads to a succession of misunderstandings between the processor and the contractor.

Ordinarily a processor with raw materials of known quantities and composition wants to manufacture a definable product. Soon after submitting his inquiries he gets requests from contractors for more information on processing procedures, utilities data, proposed operating schedules, etc. Many of these questions cannot be answered without some study; there are usually too many questions coming from too many sides to permit organized study. There is usually plenty of chemical information from the processor's research chemists but little of it has design value to chemical engineers since engineering design experiments are not always included in the chemical research. As a result, when competing contractors ask about the processor's preferences he advises each to use his own preference. This leaves the door wide open for the design of a plant at the lowest price, for in time each contractor proceeds on the basis of his own competitive intuition. At that point the processor loses control of the situation.

Even among reputable contractors the bidding procedure often deteriorates into one in which all the contractors are guilty of some compromise with good engineering for the sake of a cheap plant. Thus in a batch process plant without a prescribed operating schedule the equipment offered at the lowest cost may be small undersized vessels requiring numerous batch runs; these require so much labor that the operation does not prove to be nearly as profitable as anticipated. If the process is continuous, severe skimping becomes evident by a lack of overcapacity and holdup (important factors in good design) as well as in other factors which facilitate smooth operation with little attendance. Indeed, by cutting down on such factors the cost of the attendant labor may rise so high as to invalidate the advantages of some continuous processes.

When all of the proposals are finally received by the processor each differs so widely from the other that a far more experienced staff is required to separate and evaluate them than would have been required to prepare good specifications initially. Each proposal reflects a more or less different interpretation of what the contractor desired or what he believed the processor wanted. And it actually requires far more skillful study to evaluate dissimilar proposals than it does to have a staff or an individual capable of writing brief specifications for a desirable plant.

A plan is offered here for assembling specifications in quick-time which can bring both organization and savings into the purchase of a chemical plant. These will not be air-tight specifications because such specifications require extreme skill and experience. A brief list is given in the accompanying check list. Its purpose is to ask the purchaser the questions which must be answered or assumed for the design of the plant. It may make a substantial difference in the final cost —depending upon who makes the assumptions.

One of the objectives of the specifications, even if complete details of the projected plant have not yet crystallized in the processor's mind, is to specify a definite plant on which all of the contractors will bid on the same basis. Then, if it is desired to make some alteration after receiving the proposals, the processor can feel fairly free to make changes at reasonable cost by working with the contractor offering to build the specified plant at the lowest price.

One of the unpleasant experiences in plant purchasing, however, is the so-called "extras." These are generally the costs of lesser items which the contractor has not enumerated in

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Buy a Plant—*Know What You Need*

organized and economical.

his proposal and for which he demands addit: nal remuneration. They may add from 5 to 25 percent to the cost of the pl: .t. Some contractors have been known to bid especially low by offering an incomplete plant and then to rely on extras to provide their margins. It is ironically true of such circumstances that items furnished during the progress of plant erection cost considerably more than if they had been specifically included in the inquiry.

To the engineer who may have requested a certain allocation of funds it cau:s both embarrassment and a loss of prestige when he is obliged to approach his principals for more money to complete a supposedly well-planned job. The opportunities for extras decrease as the specifications are expanded.

WHAT DO YOU EXPECT TO MAKE?

This is the over-all statement of intention which defines only the over-all li..its of the intention without defining the intermediate steps. It should be presented quantitatively and qualitatively since the sizing of all equipment depends on the throughput of the individual pieces of equipment. The sizes of many types of equipment are also influenced by the quality of either the initial r w material or the final product. Thus, the cross-section of a distilling column is related to throughput while height is dependent upon purity of product.

One of the most serious initial decisions lies in the realistic evaluation of the future production anticipated for the pl.nt. To keep the initial cost of the plant low there should be no tendency to minimize the future growth of demand for the product. The time to provide for expansion most cheaply is at the outset. This is particularly true of continuous and smaller batch processes. Serious consideration must also be

WHAT DO YOU EXPECT TO MAKE?

(a) Capacity of plant—quantities daily, hourly or batch?
(b) Quality of products—purities and properties?
(c) Raw material—purities, properties, how stored, variations?
(d) Future program—extra capacity is cheapest at the start.

WHOSE PROCESS? HOW OPERATED?

(a) Is it standard and open to all contractors?
(b) Is it restricted by patents and licenses to an individual?
(c) Is the process your own?
(d) Is it batch, semi-continuous or continuous?
(e) Sequence preferences and tie-in with other plants?
(f) Operating schedules—intermittency and part-time labor?
(g) Guarantees—what do you expect for your money?

HOW MUCH PLANT DO YOU WANT?

(a) Equipment?
(b) Auxiliaries (piping, fittings, pumps, instruments and controls, etc.)?
(c) Engineering?
(d) Erection?
(e) Buildings?
(f) Revamp?

HOW DO YOU PLAN TO BUY IT?

(a) Firm price?
(b) Cost plus-a-fixed-fee?
(c) Cost plus-a-percentage?
(d) Maximum price?

UTILITIES NEEDED? AVAILABLE? TO BE PROVIDED?

(a) Electricity—voltage, phases, cycles, available quantity?
(b) Process water—temperature, pressure, purity, quantity?
(c) Cooling water—temperature, pressure, quantity?
(d) Steam—pressures, superheat, available quantity, fluctuations?
(e) High temperatures medium—Dowtherm or hot oil; vapor or liquid, temperature, pressure, minimum return temperature, quantity?
(f) Air—pressure, temperature, quantity?
(g) Fuel—type, quantity, quality?

DESIGN CONDITIONS

(a) Operating pressures?
(b) Design pressures as a percentage above the operating pressures?
(c) Operating temperatures?
(d) Codes, ASME U-68, U-69?
(e) Design temperatures?
(f) Instrumentation—automatic, semi-automatic, manual?
(g) Underwriters labels?
(h) Hazards?

MATERIALS OF CONSTRUCTION

(a) As determined by the fluid or solid media, composition?
(b) As determined by temperature?
(c) Solid or clad, where applicable?
(d) Percentage clad?
(e) Alternates?

SPECIAL CONSIDERATIONS

(a) Space available for plant.
(b) Equipment preferences.
(c) Other preferences.

given whether or not competitive products have been improving in purity through the years. Where purity has been improving ample overcapacity should be included in separation equipment so that it will be available when required to meet competition.

WHOSE PROCESS? HOW OPERATED?

Some processes are developed by contracting engineers and are covered by exclusive patents. Others are licensed by research or development groups either on an exclusive or a non-exclusive basis directly or indirectly to processors through contractors. Where processes are exclusively licensed, there is naturally only one contractor who can build for that specific process. There may be competitive processes, however, in which event comparisons must be made principally on guaranteed initial costs and operating costs respectively. If the process is the processor's own he must be sure that it does not infringe on any existing patents since it is not customary on the processor's process for the contractor to guarantee immunity from patent interference. If a process is assembled from among expired patents or the technological art of chemical engineering so that it appears to be outside the range of patent interference an economic preference should be established for a batch, semi-continuous or continuous process. These data should have been an integral part of the economic survey leading to the allocation of funds for the plant and should be conveyed to the contractor.

Part of the answer to the last question lies in the projected operating schedule the processor has in mind for the new process. Equipment which is to operate continuously for long periods will differ from continuous equipment which is to operate intermittently. For the latter special emphasis must be given to see that the equipment can be primed easily and that the priming operation or the going off stream does not produce a large quantity of an undesirable intermediate product even though this may increase the processing cost for the operation.

HOW MUCH PLANT DO YOU WANT?

The number of services bought from the contractor has a definite influence on the total cost of the project to the processor. The equipment usually constitutes the foundation of the purchase and such is assumed here in comparing additional services.

Does the processor intend to buy the auxiliaries from the contractor or does he intend to buy them himself? The auxiliaries include the piping, fittings, pumps, instruments, controls and the various other essentials which are not included as equipment proper.

Does the processor plan to do the engineering and procurement or will it be furnished by the contractor? The answer to this question is closely connected with the question of who will do the erection. Engineering involves the design of all the supporting members and execution of the details for interconnecting auxiliaries and devices within an allocated building or outdoor area. If the processor buys the equipment without engineering, with the intention that he will install it and erect it himself, there may be some savings on the engineering and drawings which are usually prepared by contract engineering firms. However, the total cost of engineering is relatively so small it is unwise to forego the advantages of a staff experienced in layout. A contractor's staff gives consideration to myriad details some of which may be overlooked by operating engineers, for example, the accessible location of the equipment, the location of controls and instruments in positions for simple operation, etc. Installation of a well engineered plant reduces to a minimum the amount of building to be broken up and the equipment itself is designed to facilitate support within the framework of the existing or projected building. Ordinarily, the auxiliaries cost very little, if any, more when purchased from a contractor who enjoys certain bona fide resale privileges than from the original vendor and procurement and selection are the responsibility of the contractor.

Where a new building is also a part of the projected plant the project is best initiated by conferences between the prospective contractors and the processor after which one or two of the common types of plant construction will appear most favorable.

Another point worthy of consideration is the possibility of revamping some existing equipment into the new plan;. If the amount of equipment to be revamped represents perhaps 25 percent or less than the cost of the new equipment the matter of revamping can be deferred until the most probable contractor has been selected. He will then quote allowances, including fabrication, engineering or erection as desired for each item of equipment.

HOW DO YOU PLAN TO BUY IT?

The way in which a plant is bought influences the contractor's costs and contingencies, all of which are passed on to the purchaser. Equipment alone for a plant is sold on a firm price. Depending upon the size and nature of the plant, most processors prefer to buy both equipment and some services on the basis of a firm price. Notwithstanding the receipt of a firm-price quotation, there is still the possibility that loose ends and changes which develop while the plant is being executed may incur some extras. If several quotations are received, they may be cross checked by tabulation to see if one or the other contractor has left any glaring omission which might show up later on as a sizable extra. The majority of plants in the quarter-million dollar class are bought with equipment, engineering and supervision of erection by the contractor and erection labor supplied by the purchaser. This enables the purchaser to supply part of the erection labor from his own maintenance personnel thereby adding to their familiarity with the new plant.

A form of purchase which has been popular on larger projects is the cost plus-a-fixed-fee contract. Here, because the cost of the equipment is usually not an indication of the amount of design, engineering and procurement which must be performed by the contractor, a prospective purchaser feels he has a right to know how much gross money the contractor is going to receive for services on the contract. Ordinarily, the fixed fee will run anywhere from 5 to 10 percent of the cost of the equipment plus other services and will not include contractor's out-of-pocket expenses nor the direct engineering costs which are paid for on an hourly basis or at the contractor's actual costs plus a percentage for overhead.

A type of contract which was popular during the recent war was the cost-plus-a-percentage contract. In normal times this has always been considered objectionable. The cost plus-a-fixed-fee contract gives the contractor every incentive to get the job done as cheaply and as quickly as possible. In a competitive market the cost-plus-a-percentage contract secures no advantage for the purchaser.

Still another type of contract is the maximum-price contract. In a firm-price contract the contractor includes an allowance for contingencies which is from 5 to 20 percent of the firm price. The maximum-price contract is similar to a firm-price contract except that the contractor offers to remit

all or a percentage of any savings he might obtain from the estimated maximum price during the course of the job. There is some merit to a maximum-price contract inasmuch as it is sometimes necessary to estimate entire plants in a hurry and the contractor is entirely willing to give back any excess amount.

UTILITIES

There are three important questions which must be answered on the matter of the utilities. These are: (1) Which are needed? (2) Which ones are available? (3) Which new ones must be provided? The need for new utilities can often influence the desirability of building a particular plant. The principal utilities are electricity, process water, cooling water, steam, air and fuel. The questions detailed in the check list should be answered rather comprehensively since they influence the design and size of equipment.

DESIGN CONDITIONS

While operating conditions are fixed by the process the design conditions such as pressure and temperature should be considered closely with relation to the code to be employed in fabricating the equipment. The combination of conditions, material and code can affect the total cost of the plant to a very great extent. In the absence of definitive specifications differences in design conditions, material and code can also account for large discrepancies between competing contractors. In many states and municipalities there are mandatory codes covering the elements of construction to be employed in fabricating vessels operating at pressures usually at 15 psig. and greater. Therefore, there is considerable advantage to the avoidance of design pressures above 15 psi. unless absolutely necessary. The use of simplified or generalized conditions such that all vessels have a minimum design pressure whether necessary to the process or not should be avoided. Ordinarily, when the operating pressure exceeds 15 psi. the design pressure is fixed at from 10 to 25 percent above the operating pressure.

Specification of excessive design temperatures is costly, particularly for non-ferrous materials whose working stress decreases with temperature in the low temperature range and for certain classes of ferrous castings. For the case of steel in fabricated and plate form there is no structural problem in specifying a design temperature of 650 deg. F. so long as adequate expansion facilities can be provided cheaply. For cast iron 200 deg. F. is about the upper limit. For the non-ferrous alloys the allowable working stress starts to decline rapidly above 200 deg. F. and the use of high pressures and high temperatures with non-ferrous alloys or ferrous castings should be avoided. Design temperatures are usually chosen only as much above the operating temperatures as are reasonable for the fluctuations which can result from the range or failure of controls or to incorporate a realistic safeguard against expansion and contraction.

In many cases equipment design follows the paragraphs of the ASME Code or the principal features of it which are embodied in territorial and local codes. The principal paragraphs of the code are U-68 which is an unlimited code and U-69 which is restricted but which permits a cheaper type of construction. The use of ASME U-68 should only be specified when confining a toxic fluid at a pressure or temperature beyond the limits of ASME U-69.

Use of automatic instruments is also an important cost factor since in certain processes the instruments might run as high as 25 percent or more of the total value of the equipment. For this reason, the operating schedule should be considered as well as the number of operators available to monitor the plant and those who must be assigned specifically to operate it. For the most part, there is a wide range in the amount of automaticity which may be incorporated into the design of a plant. Some instruments and controls are fairly expensive and where many instruments are to be used, it is advisable that they be air operated so as to reduce the cost of relays and motors. On electric equipment the designation of explosion-proof housings or Underwriters labels increases initial costs but permits a reduction in the insurance rate of the plant which usually permits writing off the additional cost in short time. Where special hazards are involved much can be accomplished by a discussion with commercial insurance representatives.

MATERIALS OF CONSTRUCTION

This is frequently the critical cost factor because there is such a broad discrepancy between the costs of the various alloys and non-ferrous metals compared with common materials. For example, tubing of Type 316 stainless steel may cost six times as much as equivalent tubing of carbon steel. Similar divergencies arise in the use of the non-ferrous metals. Some fluids which attack metals are passive to wood. One of the costliest decisions is incurred by the simplified specification of a single alloy or non-ferrous metal for an entire process merely because at one stage or another in the entire process a fluid is apt to cause the corrosion of baser materials. Many fluids are not corrosive at low temperatures although they are corrosive at high temperatures and some solutions which are corrosive when dilute are not corrosive when concentrated. Such questions can usually be answered by consulting standard corrosion data or running a few inexpensive tests.

The presence of a corrosive fluid does not necessarily call for the use of a solid alloy for protection. There are a wide variety of alloy clads and non-ferrous liners which can reduce the cost of the plant considerably. However, if at moderate pressures more than a 15 or 20 percent clad is desired it will usually pay to go to solid alloy. Still other savings can be made by using several alloys if there is a difference in the relative cost of fabricating each, such as stainless steel fabricated vessels and cast aluminum equipment.

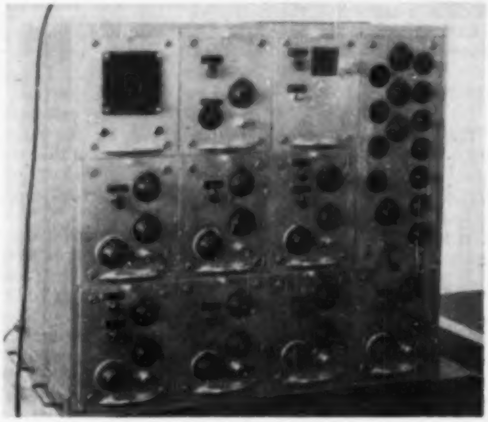
SPECIAL CONSIDERATIONS

Very often it is the purchaser who is more familiar with the circumstances that must be incorporated in a prospective plant than the contractor. Since one of the functions of the specifications is to give the processor an opportunity to air his preferences, he should not hesitate to make them known along with any unusual conditions relating to the processes. For example, it may have been found that elevating a temperature above a certain level causes discoloration or that operation at one pressure or another has a marked effect upon foaming. Any of these innumerable technological factors should all be contained in the specifications.

By running through the check list on p. 139 it is not necessary to answer all of the questions. But each question which is answered reduces the chance for misunderstanding to some extent and at the same time defines the objectives better and better. They keep the purchaser in control of the situation. Even the most cursory treatment of the check list can contribute some economy to the purchase of the most desirable plant which is, after all, the cheaper way to buy a plant.

How Analogical Computing Devices Can Serve Process Industries

Analog computers, designed to solve specific problems in process industries, are giving solutions where only trial and error formerly sufficed, where speed is essential, where some factors are unknown.



Electronic analog computer developed by Phillips automatically solves flash vaporization equilibrium equation for hydrocarbons, eliminating laborious trial and error computations.

W. L. MORRIS and F. W. BUBB

In the past ten years several universal, widely applicable computers, such as the ENIAC, the IBM-Harvard Computer, and others, have been constructed and put into operation. Because these machines can cope with almost any mathematical problem, and are spectacular in size, they have attracted much attention and have tended to obscure the concurrent development of numerous smaller computers designed to work day by day in the solution of special analytical problems which recur frequently in process and other industries.

In operating certain industrial processes, it is necessary to solve the same problem repeatedly. For such specialized use, a universal computer is neither needed nor appropriate. Instead, one needs a special computer for the problem in hand. Such special computers should be reliable in operation, capable of continuous operation over extended periods, of minimum size and cost. It has been found that a certain type of computer known as the analogical type is peculiarly adapted to these requirements.

In contrast to the universal or digital type of computer which deals only with numbers, the analogical type of computer is a physical system concerned with physical quantities. The industrial process to which the analogical computer is matched is ordinarily described by mathematical equations. The analogical computer is made so as to be governed by the same equations, and so that each quantity in the prototype process has its analog in a specific quantity of the computer. For example, a temperature in the prototype process may be represented in the computer by a shaft rotation, or a voltage, or by some other quantity. It is the analogical type of computer that we are concerned with here.

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WHAT COMPUTERS CAN DO

Analogical computers are used effectively in three types of problem: (1) Those in which analytic methods entail lengthy trial and error procedures; (2) Those in which boundary, or initial conditions, or both, are complex; and (3) Those in which speed in solution is essential to the success of the operation.

A problem often met, for which analog computers are adapted, is the type where no convenient analytic method exists for the direct computation of an answer. An example is the solution of phase equilibria in the flash vaporization of mixtures of hydrocarbons. Here the determination of V, the fraction of the composite hydrocarbons which is in the vapor state, involves the rather laborious trial and error solution of

$$\sum_{i=1}^{n} \frac{Z_i}{1 + V(K_i - 1)} = 1$$

where Z_i is the mol fraction of the ith compound of the mixture; K_i is the equilibrium constant of the ith compound; and n is the number of compounds in the mixture.

The human computer does this problem by guessing a value of V, inserting this into the equation and computing its left side, which is generally found not equal to 1. Another value of V is then chosen, the left side calculated again, and so on until a value of V is found which makes the left side satisfactorily close to 1.

The Phillips Electronic Analog Computer was developed to solve this problem (Bubb, F. W., Nisle, R. G., and Carpenter, P. G., *J. Pet. Tech.*, 2, 143-48, May 1930). The computer is an electro-mechanical system comprising a number of units, one for each component in the mixture. By the proper setting of potentiometers, the K and Z pertaining to each component are set on dials. The value of V which is common to all units is set simultaneously in all units by a single dial. A voltage of the form $E_oZ_i/[1 + V(K_i - 1)]$ is generated by each unit and these are added and compared with E_o, the line voltage, by a galvanometer. If the galvanometer

does not balance, V is varied by turning its single dial control until balance is indicated, that is, until V is such that the above equation is satisfied. When the balance is attained, V is read from the dial. Provision is also made so that once the equation has been solved for V, the mol fraction of each phase (vapor and liquid) of each compound may be read directly from the computer.

The analogy with the human process consists in the correspondence of the cut and try choice of V with the adjustment of the dial. The pencil calculations of the human computer are performed automatically and almost instantaneously by the computer.

The second type of problem is that in which the boundary conditions are irregular. Into this class fall all potential theory problems in which the boundary itself is anything other than a circle, infinite half plane or certain other idealized forms. Two specific examples of problems of this class are: the flow of heat in irregularly shaped bodies with non-simple boundary conditions, and the flow of fluids in petroleum reservoirs.

Analogical computers have been constructed to solve these problems and the two computers are fundamentally the same. The conducting medium, whether heat-conducting in the first case or fluid-conducting in the second, is represented by an electrical network of resistors and capacitors. The resistance to flow of electrical current in the network is the direct analog of the resistance to flow in the medium and the capacity of the network is the analog of the capacitance of the medium to store heat or fluid. The analog of flow, either heat or fluid, is electric current, and the analog of temperature or fluid pressure is electric voltage.

By proper design, these computers can be so constructed as to be capable of application to a wide variety of problems in each field. Thus, heat flow in one medium of irregular outline and conductivity may be computed in one problem and the computer may then be converted readily to study heat flow in a medium of completely different type and shape.

Similarly the computer designed to study the flow of homogeneous fluids in a permeable medium (e.g., a petroleum reservoir) is so constructed as to be applicable to almost any size or shape reservoir.

A third type of problem where analogical computers find a peculiar utility is that in which speed of solution is essential. The solution of systems of linear simultaneous equations is an example of this type. Such systems of equations arise in many places in process industry as, for example, in the infrared analysis of hydrocarbon streams. Here the absorption by the stream of different frequencies of the infrared radiation yields linear algebraic equations, one equation for each frequency band of radiation used. The variables are the mol fractions of each hydrocarbon compound in the stream, and the constant coefficients the absorption coefficients.

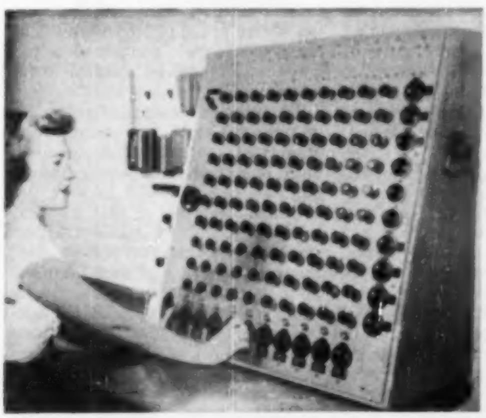
Solution of a system of this kind, although straight-forward enough, is tedious and lengthy when the number of hydrocarbons in the stream is four or more. Since this type of analysis is made for process control purposes, speed of solution is necessary in order that the operator may receive information quickly enough to enable him to maintain the stream at the desired composition.

Several computers have been made to perform this calculation. The computer in its usual form consists of a network of electrical resistors arranged in rows and columns. The coefficients are set into the machine by setting variable resistors to the pertinent values. The total extinction usually written on the right side of a linear equation is set into the machine by feeding a voltage of proper magnitude into the proper row. In one design the answers appear directly as voltages at the bottom of the columns. Incidentally, this last type of computer lends itself very well to the actuation of automatic controls for regulating the proper composition of the stream.

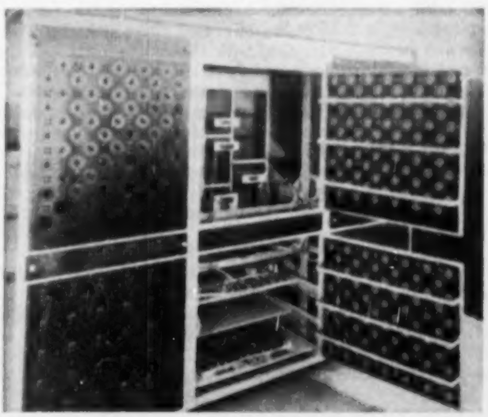
SIMULATORS

More and more often we are encountering processes, phenomena or mechanisms of such great complexity that we find ourselves in the position of knowing the end results of the process, of being able to derive but not to solve the differential equations governing the phenomena, and of being able to measure at most a part of the pertinent parameters of the system. In many such systems, magnitudes are such that a statistical or direct experimental approach is entirely impossible. Then the only known systematic approach is by construction of a "simulator".

The simulator may be a device which is indistinguishable physically from a computer. In fact, as we shall see, we normally expect to use it for



Typical of analog computers designed to speed up operations is the Phillips Spectro Computer which solves linear simultaneous equations such as those met in infrared and mass spectrometry.



Another class of device, the simulator, permits "synthetic" experiments. Here is the interior of the Phillips Reservoir Behavior Analyzer, a variation of the Carter Oil Pool Analyzer.

the computations in the next stage.

The simulator is built so as to be governed by the same differential equations as govern the prototype, and so that all variables and parameters of the prototype have their analogs in the variables and parameters of the simulator.

In operation, those parameters of the prototype which are measurable are set into the simulator and reasonable values assumed for the others. The simulator is then set in operation and allowed to proceed to the end result. This is compared with the end result of the prototype. If the two are the same, it is assumed that the simulator is a true analog of the prototype. If the two end results differ, successive adjustments of the simulator parameters are made until the two end results are the same.

Thus, we use the simulator as a substitute experimental system. Experiments may be performed on the simulator so as to give systematic direction to observations of and operations on the prototype.

Once the simulation experiments are completed, the device can be used as a computer for the solution of other problems and the study of other performances of the prototype.

An example of a simulator is furnished by application of the heat flow computer to the inverse problem of designing, say, a heat exchanger to have certain properties. In this problem, certain of the parameters such as specific conductivities and, perhaps, over-all dimensions would be known, but others such as geometrical arrangement would be the solution desired and hence unknown initially. In such a case the heat flow simulator is set up with the known parameters and with some reasonable assumed geometry. It is then placed in operation and its result compared with the desired result. If the two differ, the parameters, such as geometry of the simulator, would be adjusted until the two results are the same. The desired design is then read off the simulator, and the simulator itself is then used to predict or to compute the behavior of such a design under varying conditions.

Another example of a simulator is found in the Reservoir Behavior Analyzer. In the case of a petroleum reservoir we frequently have a fair idea about the essential parameters of the reservoir itself, its shape, size, permeability, porosity and so on, but have very little knowledge of the surrounding aquifer which is the source of the water drive.

To obtain this information, we make use of the analyzer as a simulator. We set the known parameters into the analyzer and make reasonable assumptions regarding the unknown parameters and set these in the analyzer, also. We then operate the simulator reservoir according to the production history of the prototype reservoir, and compare the pressure history of the analyzer with that of the prototype. By varying the aquifier parameters until the two pressure histories coincide we obtain what is accepted as a true analogy between prototype and analyzer. The analyzer is then used as a computer to predict future behavior of the reservoir.

AUTOMATIC CONTROL

Modern development of automatic control has been made possible only by the concomitant development of computers. In their application to, and incorporation in, automatic control systems, computers find their greatest utility. In the large sense, by organizing the several parts into a harmoniously integrated system, one achieves a final result in much the same way as an artist works out details of different portions of a picture and then completes a masterpiece by combining them all into a coherent unity.

Simple automatic control devices, such as liquid level controls, have been in use for centuries. Other devices, such as thermostats, steam pressure regulators, speed governors and the like have been used for decades. Devices of this kind are generally actuated by the quantity which they are to control. For example, a gas oven thermostat will compare the oven temperature with a standard (desired) temperature and if the ambient temperature is less than the standard, the thermostat will cause the gas flow to increase. If the ambient temperature is higher than the standard, the thermostat will shut off the gas and permit the furnace to cool down. In this case, modern terminology would call the temperature the measured variable and the flow rate of gas the controlled variable.

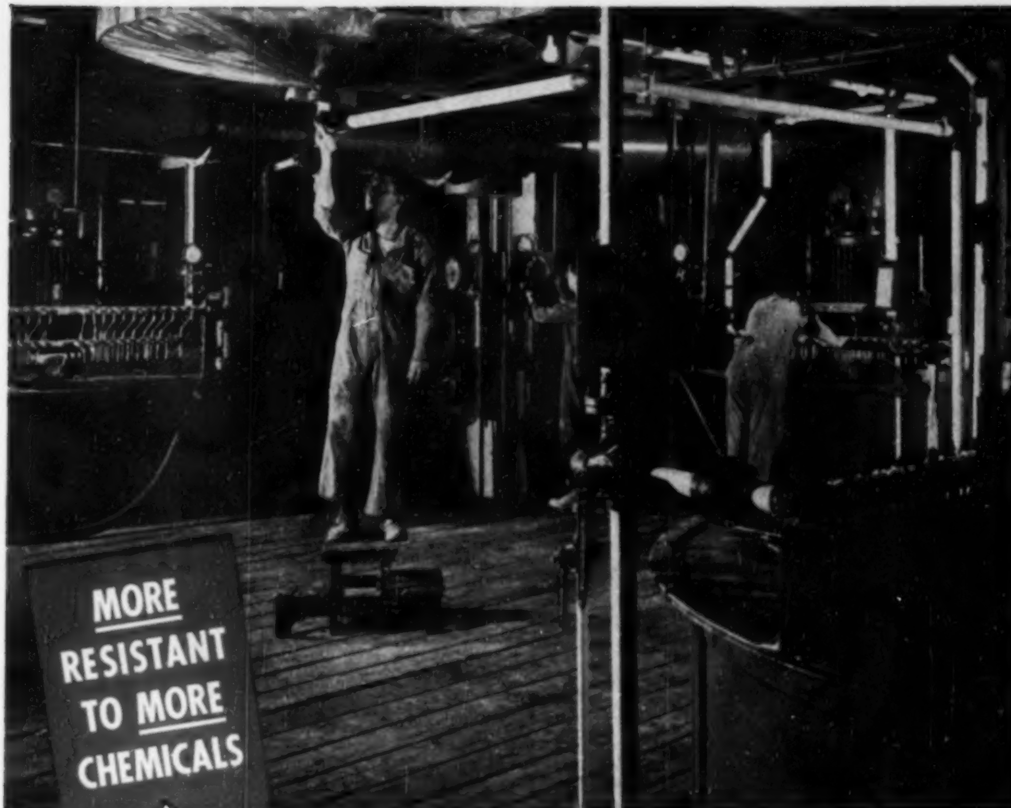
In the control of a process, however, no such simple relation ordinarily exists between the measured variables and the control variables. For example, engineers will operate a chemical process plant by making measurements such as pressure, temperature, composition, etc., at various points in the plant. These measurements are fed into formulas, such as material balance equations, mass action relations, etc., which yield answers such as valve settings, pressures and temperatures to be used, and so on. These answers are now the control variables and as such are commands to amplifiers and servos which adjust the process. In the absence of automatic controls, computations have had to be made by analytic means and the results therefrom put into effect manually.

It is now possible to accomplish this control process by construction and installation of integrated sensing-computer-control systems which (1) observe the measurable variables, (2) feed these results to computers which determine the proper values of the control variables, and (3) transmit that information to the control mechanism which finally operates the plant in response to that information.

It should be emphasized that although this picture represents an ideal, it is by no means an unattainable ideal. Many plants whose processes are thoroughly understood are, in fact, installing systems of this kind. Other plants whose processes are still in development may not make immediate use of full automatic control systems but can still make use of less comprehensive systems which, after the process development has been completed, can be integrated in the complete system.

An example is furnished by the simultaneous equation solver already mentioned. The mol fractions of the various components in a liquid or gaseous mixture appear in the computer solution as voltages. Each of these voltages can be compared with a standard voltage which will be proportional to the desired mol fraction of that compound in the stream. If one computer voltage is higher than the standard, indicating thereby too great a concentration of that compound in the stream, a motor is actuated so as to turn a valve reducing the amount of that compound entering the stream. Conversely, if the concentration of that compound is too low, the valve will be actuated to increase its flow.

To sum up, analogical computers do not need to be large instruments, of universal application and expensive, to be important to industry. Rather, they can be specialized to solve the particular problems of that industry, to do so reliably, and at a considerable saving of time and money. Furthermore, in many industrial applications, analogical computers serve by taking on the alternate role of simulators in which they act as substitute experiments where the prototype experiment is either too expensive to perform repeatedly or even impossible to perform at all. Finally, analogical computers find wide application as an integral part of modern automatic control systems.



HOT CORROSIVE SALTS almost too hot to handle

FOUR TIMES A DAY, metallic salts in hydrochloric and hydrofluoric acid solutions are heated to a near boil and cooled to room temperature, in these digesters and crystallizing tanks. The hot acids are extremely corrosive, and the constant change of temperature is rough on the tanks. Most materials would not stand up or would be too expensive.

Best answer was found in ACE hard rubber linings—the two-layer protection that is both chemically strong, and mechanically tough. Approximately 40 ACE rubber-lined tanks are now in service in this plant. Many have been on the job for eight years.

The fume ducts in the background, incidentally, handle hydrofluoric acid vapors. They, too, are ACE protected.

ACE hard rubber resists all alkalies, metallic salts, inorganic acids, hydrochloric acid any strength, nitric acid to 16° Be, sulphuric acid to 50° Be, phosphoric acid to 75%, and countless other corrosives. Other ACE plastics extend this range still further. Ask for catalogs of ACE-Clad and ACE-molded chemical equipment.

AMERICAN HARD RUBBER COMPANY
11 MERCER ST. · NEW YORK 13, N. Y.

Process Equipment News

THEODORE R. OLIVE, *Senior Associate Editor*

These cotton trousers were used one week in heavy metal chloride service and disintegrated after one washing.

Chem-Wear trousers were used three months in same service, with weekly washings, and are still in use.

Chem-Wear clothing is claimed by its manufacturers to resist 95 percent of the corrosive chemicals used in industry.

Work Clothing for Chemical Plant Use Now Being Made of Vinyon N

Known as Chem-Wear the new clothing is said to resist 95 percent of corrosive chemicals used in industry.

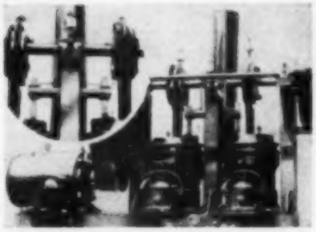
(*146A*) Savings as high as $100 per year per man are claimed as a result of using the new Chem-Wear industrial clothing which is made of Union Carbide's Vinyon N yarn, instead of conventional work clothing. Manufactured by the Chem-Wear Corp., Vinyon N garments are said to have outlasted cotton and wool trousers as much as ten to one in acid plant use. In laundering tests the clothing has withstood over 65 hr. of continuous commercial laundering in the highest caustic soap concentrations used in laundries—roughly the equivalent of 120 average washings, which is many more than conventional work clothes can withstand. Greases and waxes can safely be removed by solvents and caustics that would destroy ordinary clothing.

A recent series of tests on the fabric, conducted by an independent laboratory, showed no shrinkage and no appreciable change in pliability and hand even after 20 hr. immersion in such reagents as concentrated hydrofluoric acid, 30 percent nitric acid at 80 deg. C., 85 percent phosphoric acid at 100 deg. C., 70 percent sulphuric acid at 50 deg. C., and 50 percent sodium hydroxide at 100 deg. C.

The new clothing is not intended for protective wear since it is not coated and may allow splashes to seep through. Although it is not fireproof, it is fire resistant and will not support combustion. Its chief advantage, therefore, is to last much longer than work clothing of conventional fibers and so save the cost of frequent replacement. All conventional sizes of coveralls, laboratory coats, matched shirts and trousers, jackets and bib overalls are now available.

VALVE AND FLANGE COVERS

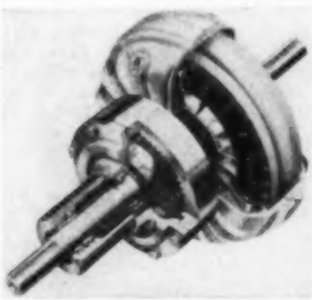
An associated concern, Milsheff, is also using Vinyon N fabric, but with a heavy coating of a vinyl compound to make it liquid-proof, in the making of valve and flange covers. These are tied on to the valve or flange as a safety feature to prevent possibility of spurts of corrosive chemicals. They are claimed to be handier than present covers and are many times lighter and cheaper than lead. Flange covers come in a complete range of sizes for 1- to 6-in. pipe, with larger sizes available on order. They are made in two types, for back welded or welded flanges, and for threaded types. Because of the many types of valve in each size, valve covers are made only to order, in which case the manufacturer will fill orders for a minimum of 50 covers for any valve type and size, made to fit the individual valve exactly.—(For clothing) Chem-Wear Corp., *740 Broadway, New York, N. Y.*; (for valve and flange covers) *Milsheff, 740 Broadway, New York, N. Y.*



REDUCES WEAR:

Sludge Pump Guide

(*147A*) A new crosshead guide assembly which can be furnished when specified on all plunger sludge pumps of its manufacture has been developed by the Ralph B. Carter Co. The guide is applicable to single, double and triple plunger pumps. It consists of a steel crosshead guide rod, rigidly secured to each plunger. The guide rod travels through bronze guide bearings in a vertical plane with the plunger. These bearings are securely mounted on the vertical stanchion of the pump base so that the guide is perpendicular to the eccentric motion of the connecting rod. This arrangement eliminates misalignment of the plunger and reduces possibility of excessive wear on the packing gland, plunger and cylinder. Constant lubrication of the guide is provided by a sight feed oiler.—*The Ralph B. Carter Co., 210 Atlantic St., Hackensack, N. J.*



FOR AGITATORS, WINDERS:

Hydraulic Drive

(*147B*) Combining a planetary gear set and an hydraulic coupling in one unit, Twin Disc Clutch Co. has developed the Hydro-Wynd Drive which is said to be particularly suitable for the constant-tension winding operations and for agitator drives where material consistency is to be controlled. The ring gear of the planetary gear set is secured to the impeller on the hydraulic coupling, while the planet gear carrier is fixed to the runner of the coupling. The sun gear connects to the output shaft. In operation, the automatic slip of the coupling reacts with the gear set against the varying torque and speed requirements of the driven machine, enabling the new coupling to replace adjustable slip clutches or other devices formerly used. As the torque load changes, the Hydro-Wynd correspondingly changes output torque—rather than horsepower—directly in proportion to the load imposed. This permits smooth, fast starts as predetermined lineal speeds and tensions, without adjustments. However, wherever the tension or lineal speed must be varied, the new drive can be used in conjunction with a conventional variable speed drive.—*Twin Disc Clutch Co., Racine, Wis.*

OIL-SEALED:

High Vacuum Pump

(*147C*) Adding to its line of high vacuum pumps, Kinney Mfg. Co. has developed a new small compound vacuum pump known as Model CVD 3534. This pump has a free air displacement of 4.9 cfm. and operates on a ⅓-hp. motor. The pump employs the same oil-sealing system used on the company's larger pumps and on a blank test is said to produce McLeod gage absolute pressure readings of 0.1 micron, or better. The pump is compact, ruggedly built and quiet in operation. The double sealing-oil reservoirs are said to provide continuous oil purification, thus promoting consistent production of high vacuum, regardless of surrounding atmospheric conditions.—*Kinney Mfg. Co., 3551 Washington St., Boston, Mass.*

DETECTS LEAKS:

Halogen Meter

(*147D*) A new meter for toxic range analysis of halogen derivatives of hydrocarbons has been announced by Davis Emergency Equipment Co. The new instrument is based on a design originally perfected by Du Pont. It

(*Continued*)

More Information . . .

To learn more about any item described here, circle the item's number on the Reader Service Postcard inside the front cover.

This Month . . .

Now that July, the month of the Tom Collins, is here, it occurs to us we may be missing a bet in not making this a special hot weather section, devoting ourselves exclusively to cooling ideas. But we've combed the files—not a single automatic bartender, nary a personal air conditioning set that plugs into the nearest ether wave, not even a salt tablet dispenser! So, back to our original love, and the equipment therefor. Even so, there are some mighty fancy ideas disclosed in the later pages. For instance, polyethylene flame-sprayed coatings to solve your tank corrosion problems, on page 148; and a new line of miniature recorders on page 150 which will add the recording function to that new graphic control panel. For something really novel in steam heating, take a look at the steam circulator on page 154. And if you have fine grinding or dust problems, the new fine material classifier on page 154 will click.

Next Month . . .

As a measure of the shape of things to come, look for a new long-life coating system combining sprayed metal and an organic film; a conductive paint for surface heating by electricity; and a clutch pulley which changes ratio automatically.

Marshall and Stevens Indexes of Comparative Equipment Costs

(1926 = 100)

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering,** Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering,** Feb. 1950, p. 123.

Industry	June 1949	Mar. 1950	June 1950
Average of all	160.6	160.0	162.1
Process Industries			
Cement mfg.	155.9	155.5	158.1
Chemical	163.9	163.5	166.1
Clay products	150.9	150.5	153.1
Glass mfr.	154.0	153.6	156.2
Paint mfr.	157.2	156.8	159.4
Paper mfr.	157.5	157.1	159.7
Petroleum ind.	160.3	159.9	162.5
Rubber ind.	162.7	162.3	164.9
Process ind. avg...	161.4	160.9	163.5
Related Industries			
Elec. power equip...	165.5	165.1	167.7
Mining, milling	164.6	164.2	166.8
Refrigerating	174.8	174.8	179.4
Steam power	152.6	152.2	154.8

employs a photoelectric photometer to indicate changes in the intensity of the blue spectrum of a copper arc discharge in the presence of organic halide vapors. Meter readings are said to be accurate within 10 percent, sensitivity increasing approximately as the number of halogen atoms per molecule. The instrument weighs 35 lb., and operates on 110-volt, 60-cycle current. It is said to be particularly suitable for detecting leaks of chloride refrigerants and the chlorinated solvents.—*Davis Emergency Equipment Co., 45 Halleck St., Newark, N. J.*

FOLLOWS ANY CURVE:

Flexible Conveyor

(*148A*) A new design of portable, flexible, gravity-roller conveyor, produced under the name of Flex-co by Berlin Chapman Co., is produced in width of 12, 18, 24, and 36 in. It can be installed in any combination of radii, for example, two 45-deg. turns, or a 90-deg. turn that has seven units in it, or a 180-deg. turn which is 10 ft. 6 in. long. Thus, the conveyor can be adapted to follow any desired pattern without regard to building design. It is also flexible in elevation, having telescoping legs which allow the height of the rollers to be set to any desired point above the floor.—*Berlin Chapman Co., Berlin, Wis.*

COVERS WIDE RANGE:

Immersion Thermostat

(*148B*) Known as the Rocket, a new pencil-type immersion thermostat has been introduced by Ulanet. The thermostat is rated at 1,500 watts at 115-230 volts a.c. non-inductive load and it can be supplied in various adjustment ranges to operate at temperatures from +100 to +700 deg. F. The instrument has a plastic adjustment knob with numerical graduations. Its rapid-responding thermal element comprises a metal tube and rod of different coefficients of expansion, securely bonded to each other at one end. The opposite end of the rod operates a switch mounted on a sturdy casting. No pivots or linkages are required. Over-ranging is said not to affect the calibration. Depending on requirements, thermo-responsive elements varying in length from 4½ to 18 in., in various alloys to suit specific requirements, can be provided.—*The George Ulanet Co., 417 Market St., Newark 5, N. J.*

PROTECTS METALS:

Flame-Sprayed Coating

(*148C*) Under the name of Nukemizing, a new flame-sprayed membrane coating has been developed by Nukem Products Corp. The new coating is said to give resistance to nearly all acids, alkalies, salt solutions and some solvents. By flame-spraying a mixture of polethylene resins, to which modifiers have been added to improve adhesion, hardness and thermal properties, an impervious resin film is formed over steel surfaces. Such coating is carried out only by the manufacturer, using special equipment developed for the purpose.

The new coating is said to be low in cost relative to other similar coatings and linings, completely without pinholes or voids, and easy to patch if necessary as a result of mechanical injury. It is said to withstand liquid temperatures up to 140 deg. F.—or higher in some cases—and fume exposure temperatures up to 220 deg. F. Installation is done on the job and imperviousness demonstrated after completion, using an electronic tester. Installation requires no flammable solvents, hence causes no fire hazard or objectionable fumes or odors.—*Nukem Products Corp., Buffalo 20, N. Y.*

WIDE SELECTION:

Teflon Shapes

(*148D*) In addition to the gaskets normally suppled, U. S. Gasket Co. is now able to supply from stock a wide variety of sheets, rods, tubes, bars and cylinders of DuPont Teflon. In addition, on slightly longer delivery, the company can provide Teflon molded specialties. Sheet is available in thicknesses from 0.063 in. up, in standard size 24x24 in., or special sizes to 36x36 in. Blocks come in thicknesses from ½ to 2 in. and in any shape upon request. Tubing is available with inside diameters from ¼ to 1½ in. and outside diameters from ⅜ to 2 in. Continuous rod and tubing can be provided in diameters up to ⅝ in. O.D., with standard lengths up to 2 ft. and special lengths up to 10 ft. in larger sizes. Cylinders come from 1 in. I.D. to 40 in. O.D., with a minimum wall thickness of ½ in.—*Teflon Products Division, United States Gasket Co., P. O. Box 93, Camden, N. J.*

HOLDS PRESSURE:

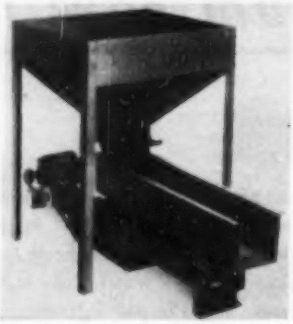
Hydraulic Test Pump

(*148E*) Milton Roy has developed a new pump, specifically designed for the testing of pressure vessels and vacuum equipment, at pressures up to 25,000 psi. The liquid end of the pump, which provides the hydraulic test pressure, has double ball-check valves said to be self-cleaning and non-clogging. The power end is an air cylinder of suitable diameter to give the desired hydraulic pressure from the available air pressure. For example, a 12-in. air cylinder driving a ⅜-in. hydraulic plunger and operating on 80 psi. air will develop 25,000 psi. hydraulic pressure. The pump operates at full stroke length and maximum strokes per minute until the prede-

(*Continued*)

New Equipment, cont. . .

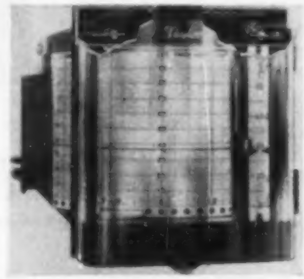
termined hydraulic pressure of the system is approached. It then automatically slows down to the speed necessary to maintain the required hydraulic pressure in the system. Overloading is impossible and the device will maintain pressure as long as required.—*Milton Roy Co., 1300 East Mermaid Lane, Philadelphia 18, Pa.*



MECANICALLY OPERATED:

Vibrating Feeder

(150A) Employing mechanical vibration to give positive action and uniform conveying speed, a new line of vibrating feeders and conveyors known as Free-Flow is being produced by the Free-Flow Co. The design is said to give a balanced construction, equalizing action and reaction within the machine and thereby preventing transmission of vibration to the building. Both conveyors and feeders are said to be self-cleaning to the last particle, quiet in operation and low in power consumption. They handle chemicals, coal and other solids over any desired length, using a single drive, and can be used for either hot or cold materials conveyed horizontally, around corners and up inclines. Sizes and capacities are available to suit users' requirements.—*Free-Flow Co., 1530 North Gordon St., Hollywood 28, Calif.*



FOR GRAPHIC PANELS:

Miniature Recorder

(150B) To enable recording instruments to be substituted for the indicating instruments presently used on the new graphic control panels now being widely adopted in process industries, Taylor has developed a miniature recording-receiving instrument with a 3-in. strip chart. Known as the Transet, the new recorder serves a receiver for pneumatic transmission of flow, liquid level, pressure or temperature. The instrument fits into a panel opening of $3\frac{7}{8}$ x $4\frac{1}{4}$ in. It comes in four forms, making possible various combinations of several functions, including one process record, set point indication, set point adjustment, valve position indication, and an automatic-manual unit for use with controllers located in the control house or field. —*Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.*

WIDE-RANGE USE:

Plastic Packing

(150C) Raybestos-Manhattan has announced a new non-jacketed plastic packing called Versi-Pak. Produced in

(Continued)

METER STUFFING BOX

(150D) Pittsburgh-Equitable is now using a new high-pressure stuffing box on its orifice meters which requires no lubricant, is claimed to be leakproof at differentials up to 4,000 psi. and is virtually frictionless in transmitting float movement to the pen shaft. The secret of the design is the use of a Teflon seal bearing, on which a spring-loaded follower bears. Teflon permits a small amount of cold flow, thus securing perfect sealing, while it is waxy in character, eliminating need for lubrication. The bearing is suitable for temperatures to 450 deg. F.—Pittsburgh Equitable Meter Div., Rockwell Mfg. Co., Pittsburgh, Pa.

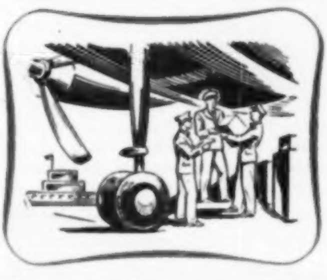
Need a pump IN A HURRY?

Your mailed order or telephone call to our branch office for a Motorpump can usually be filled immediately from branch warehouse or factory stock.

If by chance, your order requires a special motor or special pump features, our local branch engineers will...

Contact our factory concerning your requirements. These details are immediately reviewed and checked by the factory engineering department and promptly released to the streamlined production department.

Immediately the production line rolls. Your special pump is assembled by skilled workers from large stocks of available parts.



Your completed pump is soon in the hands of the shipping department from where it is sent to you by rail, motor truck or air express. In emergencies, special Motorpumps have been shipped in 24 hours.

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The standard line includes close-coupled pumps (motor or turbine drive), cradle-mounted pumps and condensate return units. Over 200 basic standard units are available with optional features and modifications to meet your special requirements. For further information, telephone, wire or write today for complete details.

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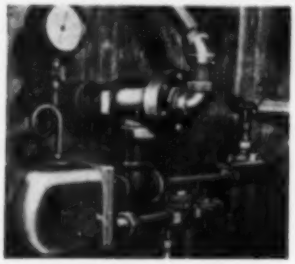
two forms, black for general service and white for special services, the new packing is said to conform readily to the shape of the stuffing box, to have greater density than woven or braided packings and to be more resilient than die-formed packings. It is claimed to be suitable for an exceptionally wide variety of applications and to give long service, increased operating efficiency, and a continued effective seal.—*Raybestos-Manhattan, Inc., Packing Division, Manheim, Pa.*



IMPROVES HEATING:

Steam Circulator

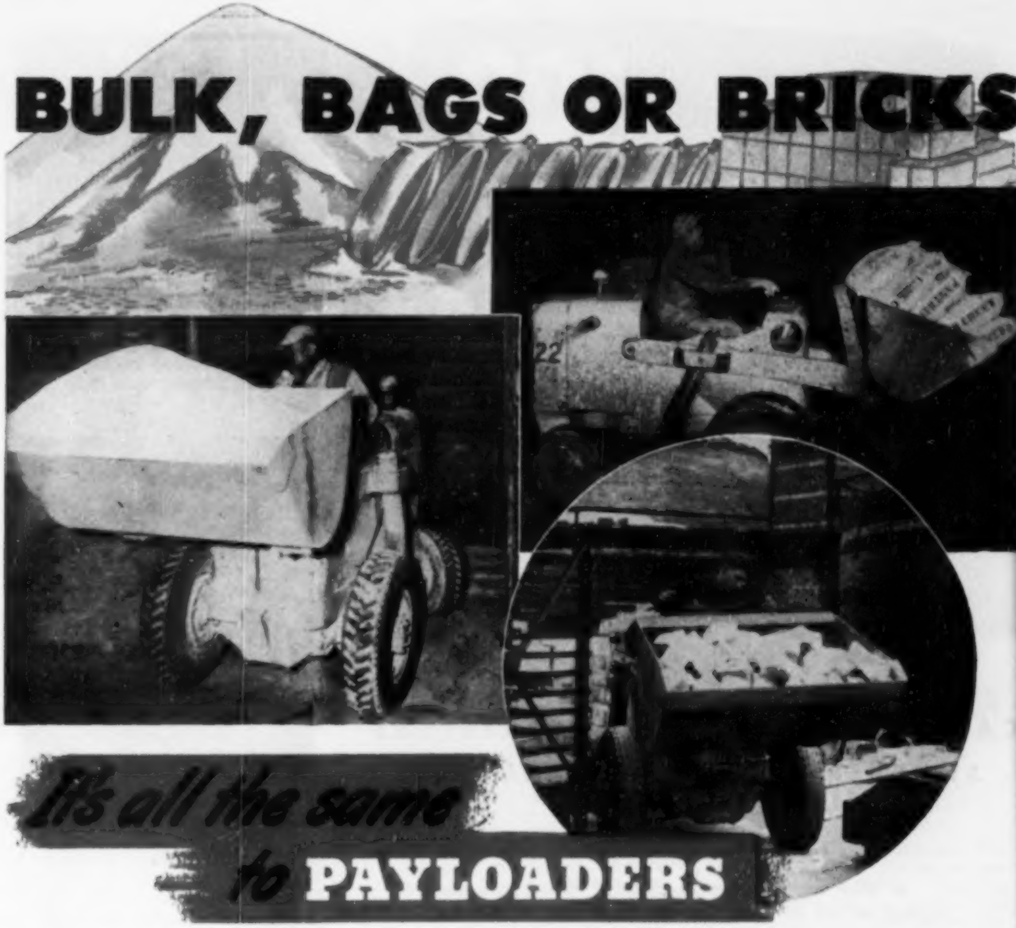
(152A) For those types of steam heated devices that have horizontal heating surfaces, such as horizontal pipe coils and platens, Sarco Co. has developed a steam circulation system which under proper circumstances gives considerable increase in heat transfer rates, thereby reducing the necessary steam consumption. For example, in one installation involving horizontal heating batteries, the use of the circulation system increased the equipment temperature from 240 to 290 deg. F., yet enabled steam pressure to be reduced from 125 to 90 psi.

The new system consists in employing in combination a small ejector of special design and a float type steam trap. The principle can be understood from the following facts: In the case of horizontal heat transfer surfaces, the condensate-air film tends to be sluggish and to present a high resistance to heat transfer. If increasing the steam velocity (as by bypassing the steam trap and supplying excess steam) will produce a turbulent flow condition in the condensate-air film, then heat transfer can be materially increased. A similar result can be obtained without waste of steam by introducing excess steam to the heat transfer surfaces, but recirculating the excess rather than venting it around the trap. In the new system this recirculation is accomplished by the small ejector.

Here incoming steam loses some of

(Continued)

BULK, BAGS OR BRICKS



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"PAYLOADERS" are designed to handle all bulk materials encountered in the chemical and fertilizer industries. Thousands of them are at work in these industries at these tasks reducing costs, increasing production and adding flexibility to operations.

"PAYLOADERS" have the power and traction to scoop up big bucket loads of tough, lumpy, granular, sticky or abrasive materials . . . have the speed and maneuverability to carry their loads *fast* outdoors or indoors, over hard surfaces or ground, mud or snow . . . to work in close quarters, to unload box cars. They dump their loads directly into piles, trucks, cars, bins, containers or hoppers—high or low, slow or fast—by means of controlled hydraulic power.

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Catalogs about "PAYLOADERS" include many varied application photos and job data. They're yours for the asking, covering the 12 cu. ft. Model HA, the ½ yd. Model HE, the ¾ yd. Model HF, the 1¼ yd. Model HL, or the big 1½ yd. Model HM.

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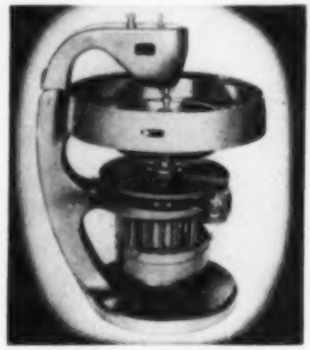
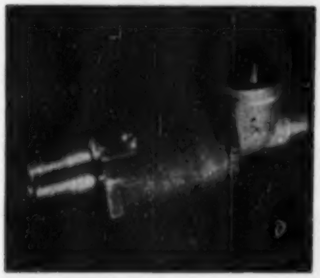
its pressure in compressing the excess steam that has completed the circuit, and in recirculating it. The illustration above shows such an installation. Incoming steam enters the ejector, flows through and enters the heat transfer coil. Excess, uncondensed steam leaving the coil is separated from condensate in a separating fitting, returning to the ejector. Condensate, however, leaves by means of the float type steam trap. Not all installations can use this system effectively, but the manufacturer believes that many designs can be materially improved in this way.—*Sarco Co., Empire State Bldg., New York 1, N. Y.*



SEPARATES MICRON PARTICLES:

Fine Material Classifier

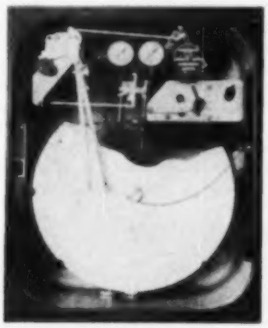
(154A) Under license from Enkoping Verkstader of Sweden, the Harry W. Dietert Co. is now prepared to manufacture, market and service the Bacho micro-particle classifier, a device for making precise separations of fine particles in the range from zero to 100 microns. A sample of fine material may be divided into eight or more particle size fractions by passing it through the classifier, with each particle size caught in a smooth container to permit weighing and determination of the percentage of that particular size material. The instrument may be used to determine the fineness of smoke particles, industrial dusts, pigments, cements, chemicals and other finely ground materials. It operates on an adaptation of the Stokes law principle, employing an air centrifuge with particle sizes separated by air velocities. A 1-hp. motor drives a rotor which produces a homogenous gyratory air field. This field is quickly changed for separating out chosen particle sizes. An analysis of eight separations can be made, it is said, in about 2 hr. without a highly skilled operator. — *Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich.*



LEAK-PROOF, PACKLESS:

Rotary Pressure Joint

(*155A*) For the handling of steam and other fluids at both high and low speeds and temperatures, Phillips Rotary Joint & Valve Co. is offering a flexible rotary pressure joint which is said to obtain a perfect seal without use of packing. The joint is made in sizes from ¾ to 3 in., in both 90-deg. angle and straight types. It is said to employ the greatest possible bearing surface on precision lapped seats. A newly patented spiral groove on the rotating member is said to prevent possible leakage between the sealing surfaces.—*Phillips Rotary Joint & Valve Co., 730 Grand St., Hoboken, N. J.*



SENSITIVE, PRECISE:

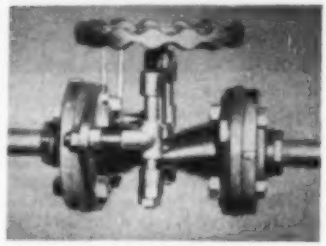
Pneumatic Controllers

(*155B*) New air-operated controllers for temperature, pressure, liquid level and flow, which are said to be sensitive, precise, and fast in operation, have been announced by Penn Industrial Instrument Corp. These controllers can be supplied with any of the usual control functions, such as on-off, proportional control, automatic reset, and derivative action. For flow control, the company's Magna Clutch method of transmission between manometer and meter mechanism is used, eliminating stuffing boxes and pressure-tight bearings. An important feature of the new controllers is their use of sapphire jewels for both nozzles and restriction to prevent wear due to

(*Continued*)

New Equipment, cont. . .

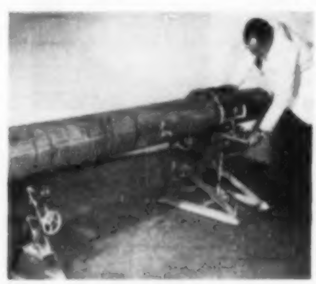
dirt, water or oil in the air. The nozzle is not adjustable. An easily accessible cleaning lever is provided for cleaning the restriction while the controller is in service.—*Penn Industrial Instrument Corp., 3116 North 17th St., Philadelphia 32, Pa.*



COMPACT, CORROSION RESISTING:

Rubber Pinch Valve

(156A) U. S. Rubber's latest development is a rubber pinch valve for applications involving corrosion or abrasion. The valve requires no packing, absorbs vibration, eliminates water hammer and is flexible enough to offset misalignment in the pipes. It can handle solids in suspension, as well as corrosive chemicals. Various sleeve compositions are employed, depending on the service. These include corrosion and abrasion resisting compounds, neoprene for oil resistance, Butyl rubber for high heat and severe acid conditions and pure gum stock for foods and beverages. — *United States Rubber Co., Rockefeller Center, New York 20, N. Y.*



ACCURATE, PORTABLE:

Tubing Cutoff Machine

(156B) To simplify the installation of stainless steel tubing by cutting to length at the point of use, Gilman Engineering & Mfg. Corp. has developed a portable stainless tube cutoff machine capable of handling any diameter from ¼ to 2¼ in. with an accuracy within 0.010 in. Since torch cutting affects the tubing properties adversely

(Continued)

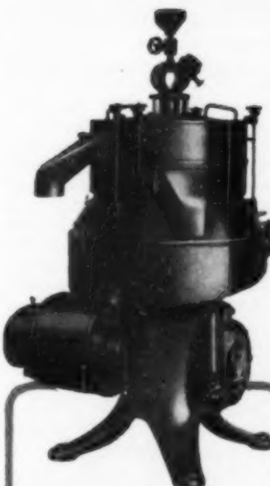
The Word is

con-tin'u-ous

"...without cessation or interruption"...Webster's Dictionary

The Method is

DE LAVAL CENTRIFUGALS



continuous

—for the separation of two liquids

—for the clarification of one or two liquids

—for the separation of two liquids plus the continuous removal of solids from one or both

All De Laval machines have one basic advantage in common—they all speed up processing operations by making them continuous. By making most effective use of centrifugal force to separate or clarify liquids, these machines eliminate costly delays that gravity or inefficient filtration methods require. De Laval centrifugals do in a few seconds work that otherwise would take minutes or even hours.

De Laval has available so many different types and sizes of machines that there is always **one** that meets your particular needs best. Ask a De Laval engineer to call.

Why De Laval?

De Laval has over 70 years experience in solving problems of separation and clarification. Your problem may be quite similar to one that has already been solved by De Laval centrifugals. It will pay you to ask.

THE DE LAVAL SEPARATOR COMPANY
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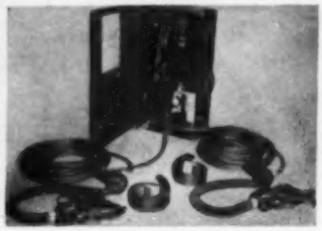
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

IT'S *De Laval* CENTRIFUGALS

for Speeding Production by
CONTINUOUS
Separation and Clarification

and the hacksaw method is slow, this new abrasive wheel method is said to save much time without undesirable effects on corrosion resistance. This concern has also developed an attachment to the machine which permits circumferential butt welding of tubes of any diameter up to 24 in. by an inert gas welding process.—*Gilman Engineering & Mfg. Corp., Janesville, Wis.*



TWO-MAN KIT:

Supplied Air Respirator

(158A) To enable two workmen such as maintenance men, to work simultaneously in an area of insufficient or objectionable atmosphere, Scott Aviation Corp. is now providing a two-man portable respirator kit of the supplied air demand type, comprising a carrying case and two complete installations consisting of air hose and a full-vision face mask. The carrying kit contains a filter and pressure reduction equipment. To use, it is simply necessary to connect to a plant air line or to a supply of bottled air. The new respirator kit carries Bureau of Mines approval. — *Safety Equipment Division, Scott Aviation Corp., Lancaster, N. Y.*

DISCHARGES POSITIVELY:

Hopper-Discharge Valve

(158B) For continuous withdrawal of dust or powdered materials from collection hoppers, Buell Engi-

neering Co. has developed a new double-gate hopper-discharge valve said to be positive in operation. The valve consists of a pair of chambers secured one above the other. In the upper portion of each chamber is a hinged gate which is normally closed. A rotating cam driven by a small gear-reducer motor alternately opens first one gate and then the other. The closing shock of the gate automatically shakes loose any clinging material. The valve's discharge capacity is 103.2 cu.ft. of dust per hr.—*Buell Engineering Co., 70 Pine St., New York 5, N. Y.*

SLEEVE TYPE:
Quick Opening Valve

(159A) Made in stainless steel for chemical and similar applications is a new line of quick-opening sleeve valves in sizes of 1, 1½ and 2 in. These valves are seatless and make use of neoprene O-rings for sealing. They operate at pressures to 100 psi. and are claimed to be leakproof without metal-to-metal contact. They are said to give full flow, to be sanitary and self flushing, easy to maintain, light in weight and self-lubricating. They are made in types 304 and 316 stainless, with coupling ends or any standard or special thread desired. The same concern is producing a quick-disconnect hose coupling also using neoprene O-rings for sealing. These couplings disconnect by hand without tools and are suitable for pressures to 250 psi. They come in the same sizes and materials as the valves.—*J O Mfg. Co., Southgate, Calif.*

COMPACT, PORTABLE:
Research Rotameters

(159B) For wide range flow measurement in research, pilot plant and field work, Brooks Rotameter Co. has developed a compact, portable kit having three integral metering tubes with two special floats for each tube, made of Pyrex and tantalum. The

(Continued)

meter gives an overall range from 0.1 cc. per min. to 0.5 gpm. of liquid, and 5 cc. per min. to 2 cfm. of air. Fittings are available in a variety of corrosion resisting metals and nonmetals.—*The Brooks Rotameter Co., Box B-2550, Lansdale, Pa.*

EASILY CLEANED:

Stainless Shovels

(160A) For chemical handling, Metalsmiths has developed a line of scoop and square point stainless steel sanitary shovels designed to eliminate all lodging places that might trap materials handled. For example, all crevices are filled in and all welds are ground smooth and polished all over. —*Metalsmiths, 560 White St., Orange, N. J.*

FULL BODIED, RESILIENT

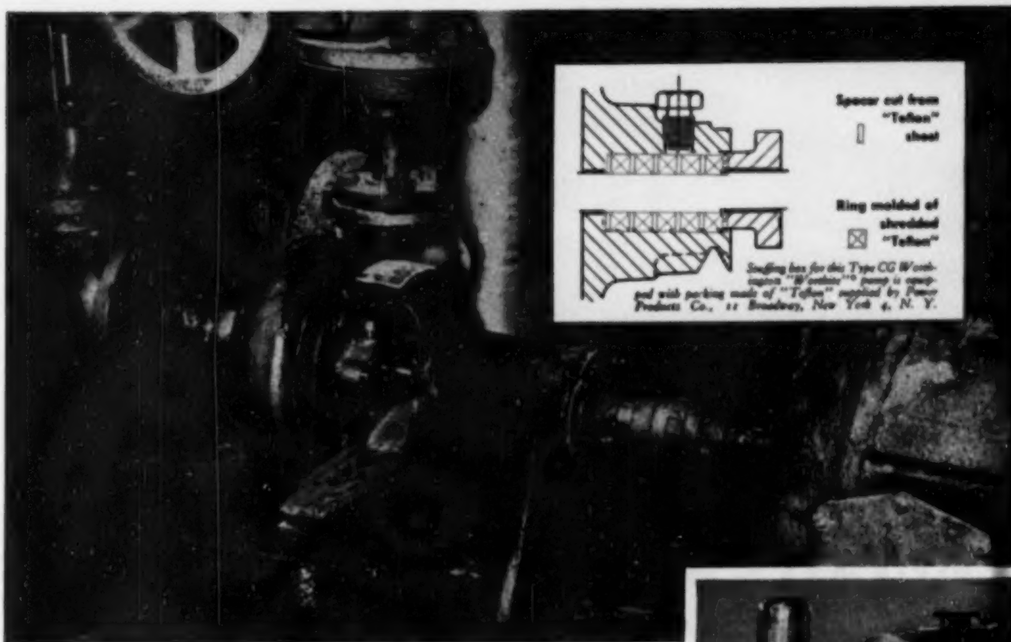
Dynel Filter Cloth

(160B) Dynel, the new spun-staple Vinyon N fiber, is now being produced as a filter cloth under the name of Feon Dynel by Filtration Engineers. Because the cloth is of spun staple rather than continuous filament, it is full bodied and resilient, making it easy to seal without requiring excessive rim pressures. Such fabrics are said to be remarkably acid-resistant and are especially recommended where hot acids are filtered. They are also resistant to alkalies, bacterial action, and a

(Continued)

HYDRAULIC DRUM FORK

(160C) Towmotor's newest fork truck improvement enables the same forks to be used for ordinary pallet handling operations and for handling steel drums without pallets. This is accomplished by placing concave notches on the inside edges of the forks to give close contact with the sides of the drums, and providing a double-acting hydraulic cylinder to move the righthand fork laterally, while the lefthand fork is anchored in a stationary position. The drums are thus picked up between the forks and supported on the rolling rings.—Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio.



HERE YOU CAN ACTUALLY SEE the packing of "Teflon" in a small proportioning pump with a stuffing box of Du Pont "Lucite"* acrylic resin. Like the packing in the Worthington pump, this packing consists of rings of molded shredded "Teflon" (dark rings) and spacers cut from "Teflon" sheets (white rings). Pump is manufactured by Proportioneers, Inc., 29 Codding Street, Providence 1, R.I.

PACKING OF DU PONT "TEFLON"* LASTS UP TO 300 TIMES AS LONG

as conventional packing in pumps handling highly corrosive chemicals

"We use pumps to handle fuming sulfuric acid and used to repack them every two days," reports one manufacturer. "In 1947, we packed our pumps with 'Teflon.' We haven't had to repack them since." This is a typical example of the extraordinary chemical-resistance of Du Pont "Teflon" tetrafluoroethylene resin.

In addition to withstanding the attack of practically all chemicals except molten alkali metals, "Teflon" exhibits its remarkable heat-resistance . . . can be used over a temperature range of −320°F. to 500°F. These characteristics, plus its extremely low coefficient of friction, account for its outstanding performance in packing in the pumping of corrosive chemicals. In many cases "Teflon" has far outlasted any other packing material tried.

"Teflon" is supplied by Du Pont in standard shapes (rods, tubes, sheets and tape). Or we will recommend molders or fabricators who can supply finished parts of "Teflon."

*REG. U. S. PAT. OFF.

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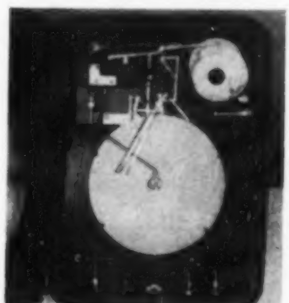
. . . THROUGH CHEMISTRY

variety of organic solvents.—*Filtration Fabrics Div., Filtration Engineers, Inc., 155 Oraton St., Newark 4, N. J.*

FOR MOLTEN MATERIALS:

Jacketed Control Valve

(*162A*) Developed primarily for handling molten sulphur at 275 deg. F. to rotary sulphur vaporizers used in the sulphite pulp industry, a new jacketed control valve developed by G. D. Jenssen Co. is also suitable for handling other molten materials, such as asphalt, wax, resins, and other thermoplastic or viscous materials which must be heated in transit. The valve body is completely steam jacketed. The chrome nickel seat is removable and the chrome nickel stem is lubricated. The valve may be operated from any standard air-operated control instrument. For safety, it is normally of the air-to-open type. Sizes are presently available from ½ to ¾ in.—*G. D. Jenssen & Co., P. O. Box 401, Watertown, N. Y.*



USES ADJUSTABLE CAMS:

Program Controller

(*162B*) To eliminate cam cutting, Gotham Instruments has developed a program recorder-controller which has a standard set of cams that can easily be adjusted to the conditions required, or readily changed when necessary. Thus, a predetermined

(Continued)

control program with relation to temperature or pressure can easily be worked out. The cams control the rate rise and length of hold, while the holding temperature is changed by turning a knob for setting the control temperature. The instrument uses a 9-in. circular chart and is housed in a 12-in. case.

With little effort and expense, the controller can be modified to control two variables at once; to reset automatically after completion of a cycle; to stop the cam at any critical point in the cycle; or to provide for the addition of signalling devices or air or electric relays or switches.—*Gotham Instruments Div. of American Machine & Metals, Inc., 149 Wooster St., New York 12, N. Y.*

Foam Fire Fighter

(163A) Now available from American-LaFrance-Foamite is a new extinguishing agent, Foamite Aairfoam liquid, which is a specially treated protein of vegetable origin compounded with additives to control viscosity, lower the freezing point and improve foaming properties. Six percent of this liquid, with 94 percent of water, and foamed with air, forms a thick, stable foam blanket at the rate of about 170 gal. of foam for each gallon of liquid.—*American-LaFrance-Foamite Corp., Elmira, N. Y.*

Plastic Lined Drums

(163B) Use of the Schori flame spray pistol has permitted the development of a new line of 30- and 50-gal. Hackney open-head seamless barrels, lined with polyethylene in thicknesses of $\frac{1}{16}$ and $\frac{1}{8}$ in. Drums with the thinner lining are priced lower than comparable rubber-lined drums. The resulting coating is said to be permanent, making the drums returnable for indefinite use. The coatings are resistant, it is claimed, to practically all chemicals.—*Schori Process Division, Ferro-Co Corp., 8-11 43rd Road, Long Island City 1, N. Y.*

Corrosive Liquid Meter

(163C) The Hays Veriflow meter, as well as the Veritrol for controlling liquid flow rates, is now made in a design suitable for the handling of corrosive liquids including salts, organic acids, alkalies and mineral acids such as phosphoric and strong sulphuric. The meter is of the positive-displacement, nutating-disk type, with a totallizing register, plus a

(Continued)

direct-connected generator for indicating flow rate. A contact-making relay is added, together with a motor-operated valve, in the controlling version of this instrument.—*The Hays Corp., Michigan City, Ind.*

Temperature Instruments

(164A) Long associated with the flow measurement field, Fischer & Porter is now producing instruments for measuring, indicating, recording and controlling temperature and pressure. The temperature instruments, named Ratotherm, cover ranges from −125 to +1,000 deg. F. The pressure instruments, named Ratogage, cover ranges from 30 in. Hg vacuum to 10,000 psi.—*Fischer & Porter Co., Hatboro, Pa.*

Process Valve Disks

(164B) Valve disks, produced from various kinds of steel, are now available as replacements for a wide range of valve types used in oil, gas and chemical industries. Produced by a series of operations involving removing impurities from the steel, blanking, hardening, tempering, Magnafluxing, flattening, grinding and finishing, the disks are guaranteed against warping and excessive breakage.—*Tri-State Mfg. & Engineering Co., Indianapolis, Ind.*

Non-Slip Coating

(164C) Under the name of Dyna-Grip, Merchants Chemical Co. is marketing a new non-slip coating which can be applied to damp or dry surfaces, wood, concrete or metal (except galvanized iron). This coating is said to be unaffected by temperature changes, while it is a non-conductor of electricity and resistant to acid, alkalies, gasoline, oil, grease and salt water. It is a formulation of abrasives suspended in a thermoplastic resin solution.—*The Merchants Chemical Co., Elm Court, Stamford, Conn.*

Small Aftercoolers

(164D) Customarily, aftercoolers for compressors have been available only in the larger sizes. The new Murphy Type V-907 aftercooler is now produced in two small sizes for 20, and for 30 to 50 cfm. of free air. The new design is a scale-down of the larger aftercoolers of this manufacturer, with careful provision for the separation of condensed moisture.—*Jas. A. Murphy & Co., Hamilton, Ohio.*

—*End*

New Products and Materials

JOSEPH A. O'CONNOR, News Editor

FOR METAL ITEMS:
Hammer-Effect Finish

(166A) A new one-coat hammer-effect finish, known as Un-i-loid, which may be sprayed on metal items at the same pressure as regular enamels, has been perfected by the United Lacquer Manufacturing Corp.

Research that produced Un-i-loid was begun when manufacturers complained that the hammer effect obtained with previously available finishes varied with the techniques used by different sprayers.

This difficulty has been overcome by Un-i-loid, United Chemists report. One coat of the new enamel, when sprayed at standard enamel pressure, immediately produces a hammer effect with a smooth, lustrous appearance. Good results have been obtained, they say, in extensive tests on oil burners, refrigeration equipment, sanitary containers and other metal items.

Un-i-loid is available in a full range of colors, and is available in either a bake or an air-dry finish.

Baking time at 300 deg. F. is 20 min. in a gas oven, or 8 min. under infrared lights. Air-dry Un-i-loid is dust free within a few minutes and can be handled within an hour. It will dry hard overnight. — *United Lacquer Manufacturing Corp., 1001 West Elizabeth Ave., Linden, N. J.*

PRICES CUT:
Surface-Active Agents

(166B) A price reduction of 3 to 5 c. a lb. on four of Monsanto Chemical Co.'s non-ionic surface-active agents has been announced.

Sterox SE and SK, both 100 percent active, are now 31 c. a lb. in tank car quantities. Sterox No. 5 and No. 6, their respective 85 percent active products, are 27 c. a lb. Corresponding decreases on smaller lots also have gone into effect.

Both Sterox SE and SK are clear pale yellow liquids stable in hard water and in acid or alkaline solutions. They are said to be compatible with builders such as phosphates or carbonates, and with anionic and cationic type detergents, both soaps and synthetics. Chemically, the products are polyoxyethylene thioethers.

Sterox SE and Sterox No. 5 are designed for use where maximum solubility and clarity of solution are desired in applications requiring a high degree of surface activity or detersive action over a wide range of concentrations and temperatures in hard or soft water.

Sterox SK and Sterox No. 6 are used for their very fast wetting action, good emulsifying properties and high level of detergency. — *Monsanto Chemical Co., St. Louis 4, Mo.*

INTERMEDIATES:
Isobutyl Amines

(166C) Sharples Chemicals Inc. announces that isobutylamine and diisobutylamine are available for the first time in semi-commercial quantities. Commercial production can be initiated if demand warrants.

Isobutylamine, $(CH_3)_2CHCH_2NH_2$, has a molecular weight of 73.1. It is water-white, has a specific gravity at 20 deg. C. of 0.73-0.74. The product contains a minimum of 97 percent amine. It starts boiling at 64 deg. C., with 95 percent distilling between 64 and 71 deg. C. Final boiling point is 75 deg. C. Flash point is less than 20 deg. F. Viscosity at 60 deg. C. is 0.33 centipoise.

Diisobutylamine (MW. 129.2) has as its formula $[(CH_3)_2CHCH_2]_2NH$. Also water-white, its specific gravity at 20 deg. C. is 0.74-0.75. The product consists of a minimum of 98 percent of the amine. Distillation range is 134 to 141 deg. C. Flash point is 85 deg. F., and viscosity at 60 deg. C. is 0.44 centipoise.

These two chemicals are promising intermediates for use in the agricultural, petroleum, pharmaceutical, plastics, rubber and textile industries. Samples and prices are available from the producer. — *Sharples Chemicals Inc., 123 South Broad St., Philadelphia 9, Pa.*

FOR POLYSTYRENE:
Anti-Static Agent

(166D) A new anti-static and cleaning agent developed specifically for polystyrene moldings, film and other articles is now being manufactured by the Chemical Development Corp. Called Anstac PS, it is an inexpensive, highly effective, fast drying liquid.

The treated product is completely anti-static, thus eliminating the attraction of dust and dirt that spoils the appearance of polystyrene and causes scratches. Anstac PS has a

CLEAN SWEEPDOWN, BUT NOT FORE AND AFT

(166E) Philadelphia launched its annual "Clean-Up, Paint-Up, Fix-Up" campaign recently by dispatching this task force of two street-cleaning flushers to spray a stretch of Broad St. in the heart of the city at noon with a mixture of water and Ultrawet, a synthetic detergent made by the Atlantic Refining Co. The heavy foam created by the solution attracted the attention of thousands of pedestrians. The city used the Ultrawet solution every night for the rest of the month to clean the central city streets, from Walnut to Arch and from Fourth St. to the Schuylkill River.—Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa.

high affinity for polystyrene and will last almost indefinitely under normal handling. It is water resistant but may be removed if desired by hot water and soap. Samples and additional technical data can be secured from the manufacturer. — *Chemical Development Corp., Danvers, Mass.*

FOR VINYLS:
Pair of Stabilizers

(167A) Claiming outstanding heat and light stability, clarity and improved life of product, Advance Solvents & Chemical Corp. announces two new stabilizers for the vinyl plastics industry.

First of these is Stabilizer S No. 52, a new organo-tin stabilizer that yields outstanding heat and light stability in all types of vinyl chloride and copolymer resins and notably improves clarity. It is a low viscosity liquid that can easily be incorporated into resins. The stabilizer is therefore suited for transparent film work, including rigid vinyl sheeting.

The other new product is Stabilizer S No. 21, an ideal heat and light stabilizer for straight polyvinyl chloride polymers. It is a mobile, easily incorporated liquid. Stabilizer S No. 21 differs from the usual metal salt stabilizers in that it combines the stabilizing action of cadmium with a radical that is a powerful acid accepter.—*Advance Solvents & Chemical Corp., 245 Fifth Ave., New York 16, N. Y.*

HOT-PRESSED:
Synthetic Mica Ceramic

(167B) A new ceramic material consisting of a fine-grained aggregate of synthetic fluorine-mica crystals has been produced by researchers at the Electrotechnical Laboratory of the U. S. Bureau of Mines in Norris, Tenn. The work was done under an Office of Naval Research contract. Bodies of very low porosity (less than 0.5 percent) are made by hot-pressing a finely powdered synthetic mica at temperatures 100 to 200 deg. C. below its melting point. So far, 92 cylindrical samples, 2 or 3 in. long and 1¼ in. in diameter, have been made. Extensive X-ray diffraction studies have shown that the material consists almost entirely of mica.

One of the most interesting properties of this ceramic is its softness. What's more, it can be drilled, sawed, milled, threaded, turned on a lathe, or otherwise worked with machine or hand tools. A high degree of dimensional precision can be attained because the material does not require further heat treatment after machining.

Other important characteristics of this ceramic are its good chemical stability and weather resistance. Samples exposed to the pressure of water vapor in a bomb at 600 deg. F. for two weeks have shown negligible changes in weight and no significant disintegration. This would appear to be a great improvement over the behavior of commercial glass-bonded natural mica products.

Composition of the material can be varied over wide limits. Most of the different fluorine-mica compounds may be made in the form of a hot-pressed ceramic. This means that a high degree of latitude and control of the various properties of the material are possible. The properties may be varied still further by the introduction of other compounds such as oxides, silicates, fluorides, carbides and graphite.

Dielectric properties of the new ceramic have been studied at the Squier Laboratory of the Army Signal Corps. The dielectric constant at 1 megacycle ranged from about 5.5 to 7.0. The best value for the dissipation factor was about 0.012, loss factor 0.067. These values by no means indicate the best that can be expected from the material. All samples so far were made in graphite dies and were distinctly gray-colored throughout due to carbon contamination. Presence of even a little carbon in such a body has a very detrimental effect on the dissipation and loss factors.—*U. S. Bureau of Mines, Electrotechnical Laboratory, Norris, Tenn.*

FOR ELECTRICAL USES:
Silicone Resins

(167C) Two new General Electric silicone resins for electrical applications have been announced.

One, designated GE silicone insulating resin No. 81132, is a flexible resin of good drying speed. It is tough, fast-drying without a catalyst, has excellent build on glass cloth, and good heat life. It is intended for use as a coating on glass cloth and glass sleeving, and as a sticker for mica-glass tape and other flexible mica products. It is supplied as a 60 percent solution in toluene.

The other new resin is designated GE silicone resin No. 81145 and is supplied as a 50 percent solution in petroleum spirits. It was designed for bonding and impregnating motors, generators, and transformers requiring Class H insulation. However, it may be used in bonded mica tape, and glass combinations. When extreme flexibility is not desired it can be used effectively as a coating for glass cloth and sleeving. When properly cured it is a relatively hard resin but maintains a high degree of flexibility. It will through-cure readily and develop good bonding properties at elevated temperatures. It is to be used as furnished; no catalyst is necessary.—*General Electric Co., Chemical Department, Pittsfield, Mass.*

RESIST CHEMICALS:
Concrete Floor Enamels

(167D) Hysol concrete floor enamels, new materials for protecting concrete surfaces from acids and other chemicals, have just been developed by Houghton Laboratories Inc. Claimed to offer outstanding abrasion and wear resistance under all circumstances, these chemically inert enamels resist

(Continued)

More Information . . .

To find out more about any of these new products, circle the item's number on Reader Service Postcard inside the front cover.

This Month . . .

Ever plagued by the problem of separating alcohols from non-alcohols? Turn to p. 168 and learn about citraconic anhydride. Its reaction with alcohols permits such a separation. . . Manufacturers of protective coatings will be interested in the unsaturated secondary alcohol described on p. 170. Polymers made from it provide good coating vehicles. . . on p. 174 you'll learn about a new accelerator activator for natural and synthetic rubbers. This activator is designed for use with thiazole and thiuram primary accelerators. . . Two improved brush killers are described on p. 176. They have a higher equivalent acid content and lower volatility. . . Finally, you may be interested in the new pump fluid, p. 176, for diffusion pumps in high-vacuum service.

Next Month . . .

Among new products to be reported on will be a new resin for paper manufacturers. It imparts great wet strength to paper. . . Also watch for the story on two white lead pigments that are non-reactive to vehicles containing free carboxyl groups.

GRASS KILLER GOES TO MARKET

(168A) Demand for the new sodium trichloroacetate perennial and annual grass killer has grown steadily since the product was first used commercially in 1949. To keep pace, Dow Chemical Co.'s agricultural chemical division has expanded its Sodium TCA production facilities 90 percent. This is a packaging unit in Dow's enlarged plant. Here Sodium TCA from the hopper is screened and weighed into the fiber drums in which it is shipped.—Dow Chemical Co., Midland, Mich.

NEW PRODUCTS, *cont.* . . .

the action of mold growth, gases and chemicals such as 10 percent concentrations of commercial acids and alkalis that ordinarily deteriorate concrete floors and walls.

Odorless and non-contaminating when dry, Hysol enamels are applicable by conventional brushing methods. They are available in iron red, gray and green. Average coverage is 350 sq. ft. per gal. with a single coat satisfactory for most installations.

Hysol concrete floor enamels are solutions of inert synthetic resins with outstanding thermal stability, chemical stability and resistance to wear and abrasion. Non-oxidizing and fast drying, they provide a tough, non-porous film that will not saponify. Tests have shown that these coatings easily resist the action of such things as 5 percent sodium hydroxide, ammonium hydroxide, motor oil, corn oil, butter, oleic acid, phosphoric acid and nitric acid. —*Houghton Laboratories, Inc., Olean N. Y.*

REACTIVE:

Citraconic Anhydride

(168B) A chemical of potential commercial importance is citraconic anhydride. Smith-New York Co., Inc., has been pushing work on it in laboratory and pilot-plant stages. Research chemists will be interested in its reactions with amines, dienes and alcohols. Chemical engineers and industrial chemists will be interested in its use for separating alcohols from non-alcohols, as well as in its use in the plastics field.

Citraconic anhydride is a white liquid of extremely high density and is easily handled. It freezes when cooled in ice; it melts at 6 deg. C. and boils at 213 deg. C. It is one of the densest organic liquids not containing halogen atoms.

Citraconic anhydride has the remarkable property of being stable in the presence of water in a reversible reaction. It reacts readily with water, and at room temperatures the resulting acid, citraconic acid, is very soluble and is stable. The mixture, however, can be distilled to obtain water and citraconic anhydride. This property is to a degree true of all cis-dicarboxylic acids; however, citraconic anhydride represents the extreme condition.

In water, citraconic anhydride hydrolyzes more slowly than itaconic anhydride. Being a liquid, it is more soluble in many organic solvents, and this permits in certain cases higher concentrations in its use as compared with maleic anhydride.

With cold water, citraconic anhydride forms two layers, and they may be easily separated owing to the high density of the anhydride. This permits separation following regeneration from aqueous solutions. The reaction of the anhydride with water is not energetic.

While it is more expensive than

(Continued)

phthalic and maleic anhydrides, where advantages of citraconic anhydride are apparent the additional cost is overcome by its ease of regeneration and re-use. This results in a low-cost chemical. At temperatures of 100 deg. C. and over, it apparently exists in equilibrium with hot water, the anhydride being favored. Thus, if cooled, the anhydride layer may be separated from the water layer before it is hydrolyzed.

The anhydride reacts with primary amines to yield crystalline products; however, with secondary and tertiary amines, the products are not usually crystalline. It reacts with alcohols without a catalyst to form unstable half-esters. This is the basis for the separation of alcohols from non-alcohols. It reacts with conjugated double bond systems in the Diels-Alder reaction to form adducts. This suggests uses in the production of compounds with angular methyl groups and in the separation of diene systems from either moieties.

Most unique property of citraconic anhydride is the fact that because of its physical structure and arrangement, its reaction products tend to decompose to yield back citraconic anhydride. The monoamide, for example, hydrolyzes in water almost immediately to the ammonium salt of citraconic acid. Some monoamides upon distillation yield back the amine and citraconic anhydride. Monoesters decompose upon distillation and give the original alcohol and the anhydride. The diesters, however, are stable.

The citraconic moiety imparts a high refractive index to its liquid derivatives. Esters of this and its related compounds in plastics are clear and very satisfactory. The amides are very soluble in water.

Smith-New York has prepared many derivatives of citraconic acid, including salts, esters, acid chloride, and amides. These may be purchased in experimental quantities. Additional technical data on citraconic anhydride is also available.—*Smith-New York Co., Inc., Freeport, Long Island, N.Y.*

UNSATURATED:

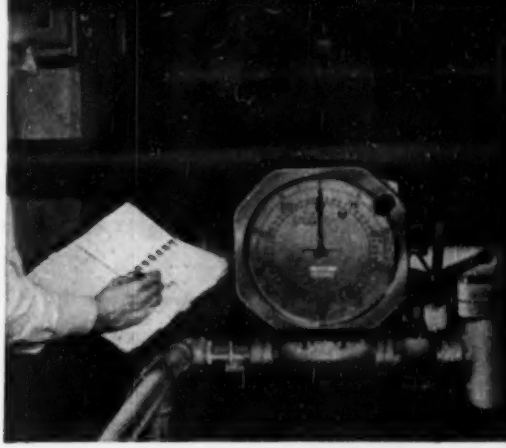
Dicyclopentenyl Alcohol

(*170A*) Pilot-plant quantities of dicyclopentenyl alcohol, an unsaturated secondary alcohol obtained by hydration of dicyclopentadiene, are now being offered by the Rohm & Haas Co.

This C_{10} alcohol has a boiling point of 239-241 deg. C. at 773 mm. (without decomposition), a flash point of

(*Continued*)

Accurate Measurement is So Easy with NEPTUNE METERS



Neptune Meters are made for men who are hard-boiled about profits and losses in liquid processing operations. Accurate Neptunes substitute unerring precision for the element of human error. They stop spoilage, spillage, and underfilling. They work fast—no slow weighing or batch tanks. Fine-instrument accuracy gives you constant control over product quality—and also keeps close watch over inventory.

They boost good house-keeping, too. Simple, easy to clean, they keep messy or hazardous liquids inside the pipe. Many types now available for handling more than 100 different liquids—including the new "432" push-button Auto-Stop for automatically feeding water and liquid sweeteners to batching or blending. Composition bronze. Sizes ⅝" to 6", for rates to 600 gpm. Easy to read, easy to operate, easy to calibrate, and easy to service with interchangeable parts. For quick facts, just use the coupon. Or phone the nearest Neptune branch.

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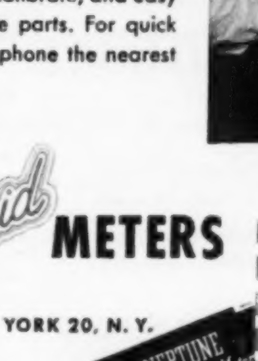

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426 deg. F., and an iodine number of 169. It is insoluble in water, and miscible in all proportions with nearly all the common organic solvents.

Derivatives of dicyclopentenyl alcohol, such as dicyclopentenyl linoleate and allyl dicyclopentenyl maleate, have interesting air-drying and polymerizing properties, indicating potential uses in the coatings field. In general, the dicyclopentenyl group contributes toughness and hardness with an improvement in water and alkali resistance.

Other derivatives of dicyclopentenyl alcohol which might be interesting as raw materials for coating vehicles include di-(dicyclopentenyl) adipate or maleate, and vinyl dicyclopentenyl ether.

Dicyclopentenyl acrylate and methacrylate are monomers that copolymerize with a wide variety of other monomeric materials and impart air-drying or heat-curing properties to the copolymers.

In addition to the preparation of esters and a vinyl ether, dicyclopentenyl alcohol may be oxidized to a ketone, hydrogenated to the saturated alcohol, dimerized to a C_{20} alcohol, and made to undergo all the normal reactions of a secondary alcohol such as oxidation to a ketone, cyanoethylation, reaction with ethylene oxide, and formation of acetals. Chlorine may be added to the double bond and the hydroxyl converted to a chloride.

Dicyclopentenyl linoleate polymerizes to an insoluble coating when air-dried or baked in the presence of metallic driers. Preliminary tests on this material were done with 0.05 percent cobalt, 0.03 percent manganese and 0.05 percent lead. Films were applied over tin and black plate at 3 mm. Baking schedules were 1 hr. and 2 hr. at 300 deg. C. The baked material was nailproof at both schedules, and had somewhat the film characteristics of a coating from a baked unbodied oil. For such a low viscosity material, however, it was unusual in showing little tendency to gather, pit or crawl during the baking. Resistance to boiling water for 30 min. was good. The films failed in less than an hour when immersed in xylol.

Air-dried films were similar to those of linseed oil although, in general, they showed better hardness.

One of the most interesting potential uses for dicyclopentenyl linoleate is as a thermosetting plasticizer for the more unusual types of coating resins utilizing vinyl type polymerization. Typical of these are diallyl

(Continued)

maleate and unsaturated polyesters prepared from glycols and maleic anhydride with or without a saturated dibasic acid. Dicyclopentenyl linoleate is completely compatible with materials of this sort and copolymerizes with them during the curing operation. Films of such mixtures have good adhesion, toughness and gloss and, in many cases, outstanding resistance to water, caustic and strong solvents. In mixtures such as these, conventional metallic driers should be omitted; peroxides may be used instead.

Allyl dicyclopentenyl maleate is another interesting film-forming material. It can be "bodied" to a high viscosity with peroxide catalysts, and air-dried or baked films have good hardness and toughness. Allyl dicyclopentenyl maleate is miscible with drying oils and a 1:1 mixture with linseed oil baked 1.5 hr. at 150 deg. C. gave a pale, hard, tough, adherent, marproof coating on metal. Flexibility can be improved by coreaction of the allyl dicyclopentenyl maleate with a diethylene glycol maleate polyester.

Samples and technical data can be obtained from the producer.—*Rohm & Haas Co., Washington Square, Philadelphia 5, Pa.*

AMINE TYPE:
Accelerator Activator

(174A) Aktone, a new amine type accelerator activator designed for use with thiazole and thiuram primary accelerators, produces maximum increase in activity and minimum scorchiness at substantial cost savings. Developed in the research laboratories of the J. M. Huber Corp., Aktone effectively activates MBT and MBTS both in natural rubber and GR-S with little or no increase in scorchiness.

More active in GR-S, Aktone helps to reach an equal state of cure in both hydrocarbons in blends of natural rubber and GR-S. In natural rubber, Aktone is very effective in gum stocks and those with clay and furnace black loadings.

For GR-S and cold rubber camelback compounds, a combination of equal parts of Aktone and MBTS has proved to provide good acceleration. This combination substantially reduces the tendency to set up in storage and maintains curing rate after long storage periods. Aktone can be obtained in both flake and powder form; specific gravity of the flake is 1.32, while the specific gravity of the powder form is 1.50. Both forms of Aktone are white and have a 90 deg. C. softening point. At high humidity Aktone is

(*Continued*)

hygroscopic. It has been used in cold rubber and natural rubber formulations, as well as in blends of natural rubber and cold rubber, natural rubber and GR-S, and cold rubber and GR-S.

Aktone is shipped in 50- and 80-lb. multiwall paper bags.—*J. M. Huber Corp., 342 Madison Ave., New York 17, N. Y.*

ESTER TYPE:
Brush Killers

(*176A*) Chemical brush killers containing new type ester formulations are effective on a wider variety of brush and weeds than previous formulations. What's more, these chemicals, now to be had from Dow Chemical Co., are less volatile than materials previously offered.

The acid equivalent content of two products, Esteron Brush Killer and Esteron 245, has been increased from 3.34 to 4 lb. per gal. Both products have an improved range and effectiveness of control, according to Dow, and at no increase in price.

These improved brush killers are formulated with esters of low volatility. Esteron 245 contains propylene glycol butyl ether ester of 2,4,5-T. Esteron Brush Killer contains 50 percent of this ester and 50 percent of the same ester of 2,4-D.

Dow points out that while the new formulations are less volatile, the user should exercise care in their application, especially in the control of spray drift.—*Dow Chemical Co., Midland, Mich.*

FOR HIGH VACUUM:
Pump Fluid

(*176B*) National Research Corp. now has in stock ready for sale Narcoil-20, its new diffusion pump fluid. This is di-2-ethylhexyl sebacate specially treated for high-vacuum use.

With this new ester, pressures as low as or lower than those obtainable with any other pump fluid can be attained. National Research recommends the fluid for its own line of standard purifying type oil diffusion pumps. This oil is also recommended for use in any diffusion pump for service where pressures of less than 0.1 micron are required.

The fluid is available in pint, quart and gallon containers for laboratory to plant-scale applications. It should be of particular interest to large users of diffusion pump oil, such as manufacturers of cathode-ray tubes.—*National Research Corp., 70 Memorial Drive, Cambridge, Mass.*

—End

TERM OF ACTIVITY FOR THESE TROUBLEMAKERS HAS

Expired

. . . YOU CAN SAY EXACTLY THAT WHEN YOU INSTALL THE . . . .

CASH STANDARD *Streamlined* PRESSURE REDUCING VALVE TYPE 1000

THESE ARE THE BENEFITS YOU GET

1. Maximum capacity when needed most.
2. Accurate pressure control under toughest working conditions.
3. Trouble-free service.
4. Smooth operation.
5. Tight closure.
6. Speedier production results.
7. Elimination of failures.
8. Cost-saving operation.
9. No spoilage.
10. Practically zero in maintenance.

USERS TELL THE BENEFITS . . .

"Our CASH STANDARD '1000' valve is used on a steam motor car to reduce the boiler pressure from 800 psi to 100 psi for the operation of a turbo generator for driving the fuel oil burner and blower. It operates by means of a pressure operated relay valve when the vehicle is not running, every time that the fire under the boiler goes on and also floats a storage battery on the line. I like the CASH STANDARD '1000' reducing valve because it is SIMPLE IN CONSTRUCTION, LIGHT IN WEIGHT, AND REQUIRES PRACTICALLY NO MAINTENANCE."

—from an engineer

"The CASH STANDARD '1000' Valves that we have in this plant are proving most SATISFACTORY IN ALL RESPECTS."

—from a manufacturer

"Most of our Type '1000' Valves have been in service for about 4 years and HAVE NOT REQUIRED ANY ATTENTION in that time except to adjust for different pressure requirements."

—from a manufacturer

"The CASH STANDARD '1000' Valves that we have in use have given us ABSOLUTELY NO TROUBLE and are preferred by our engineers to anything else on the market."

—from a vice president

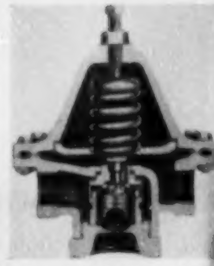
"The ELIMINATION OF STEAM LEAKS and LOW MAINTENANCE COST have been especially gratifying. The LOW INITIAL COST, LOW MAINTENANCE, and TROUBLE FREE OPERATION results in the MOST ECONOMICAL PRESSURE REDUCING VALVE we have been able to purchase."

—from an instrument engineer

WRITE FOR BULLETIN 962

• **BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES**

Send for them •



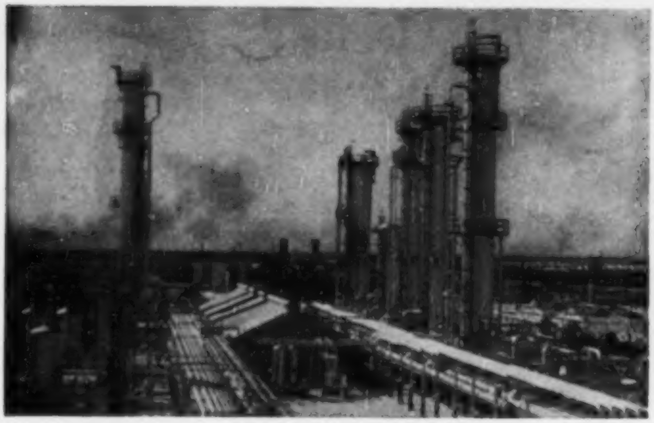
Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valve for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.

Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS



Pure hydrocarbons are products of this new plant in West Texas. Pure propane and butane are made. Pentanes and other light gasoline fractions are also separated.

Hydrocarbons From Natural Gas

This new Sid Richardson gasoline plant near Kermit, Tex., is designed to recover 75 percent of the propane in the raw natural gas and 98 percent of the butane and heavier homologs contained in the feed-gas. At appropriate points in the system, ethane-rich fractions are also available for further processing. Pentanes and other light gasoline fractions are also separated, ready for further processing as needed.

The plant takes gas from the Keystone field at 600 psi. and lower pressures. Low-pressure gas is compressed to 600 psi. and mixed with the high pressure feed-gas where it enters the absorbers. Then countercurrent absorber oil strips the gas, which is delivered to the pipeline customer. Rich-oil is taken from bottom of absorbers, methane is removed, compressed and returned to gas line. Ethane is eliminated by an re-absorber and rich-oil is passed to a still. Next the overhead fraction of the still is fed to a fractionating section where a series of columns separate residual ethane and then take out butane and propane. The separated streams of propane, butane and grade gasoline are each passed to treating units to remove hydrogen sulphide and partially remove the mercaptans by means of caustic washing. Finally the products are treated with cuprous chloride to convert remaining mercaptans into non-corrosive disulphides. The caustic used in the treatment is regenerated and the mercaptans are recovered in the regeneration process.

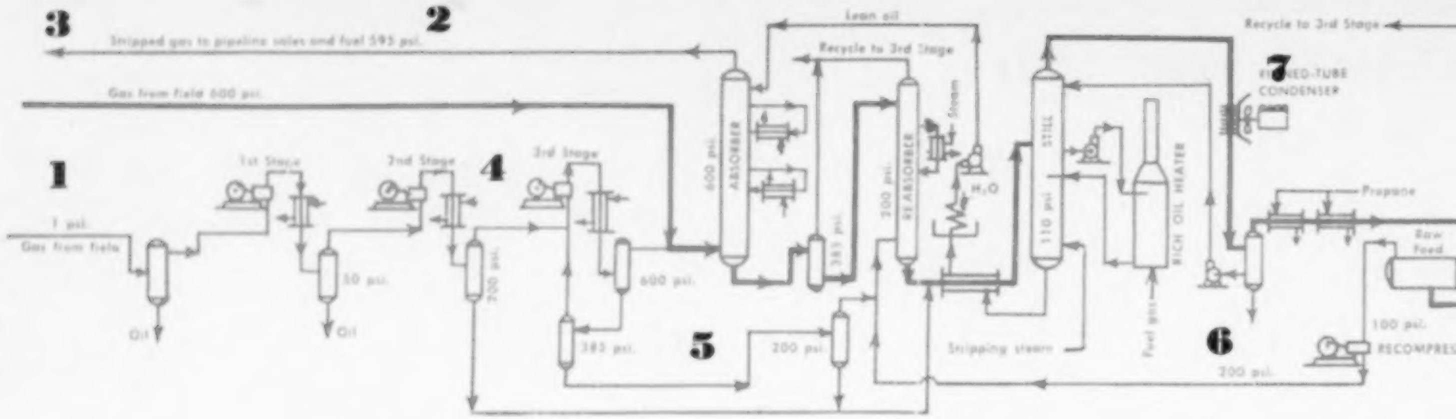
FOR MORE DETAILS see the plant description article by H. H. Jones and J. T. Cox, Jr., on pages 110-112. They have prepared a comprehensive explanation of this modern natural gas processing unit.

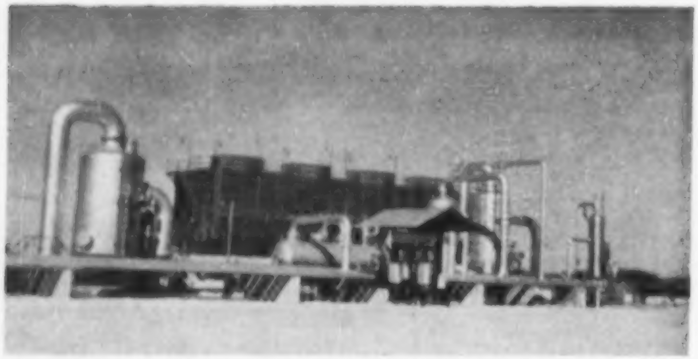
This plant recovers 75 percent of the propane and 98 percent of butane and heavier homologs from the gas.

COMPRESSION

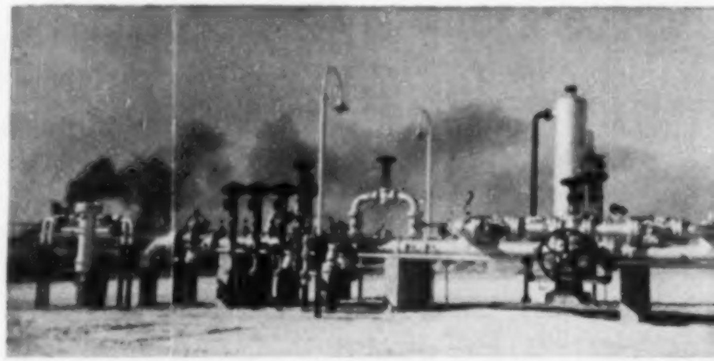
ABSORPTION

STRIPPING



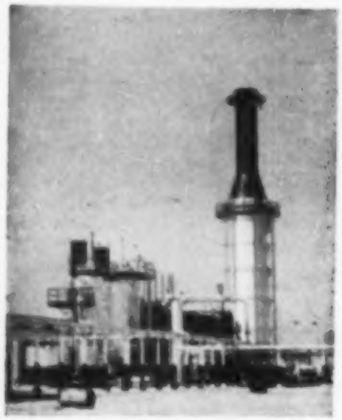


1 Scrubbers are used to remove mechanical debris and entrained water from the raw feed gas as it enters the plant from the Keystone natural gas field.

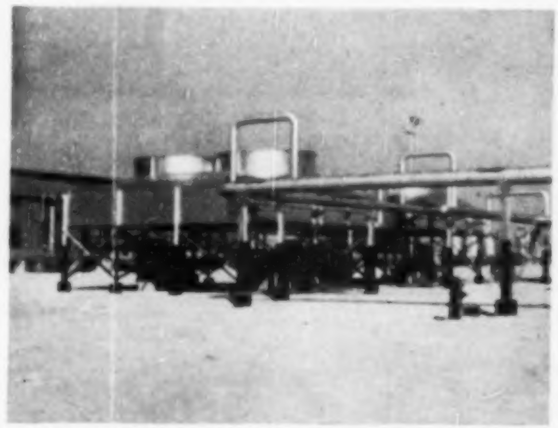


2 Pressure control station is used in the line carrying gas out of the plant after it has been stripped of propane, butane and heavier hydrocarbons.

5 Absorbers and still for primary stripping are shown from left to right.

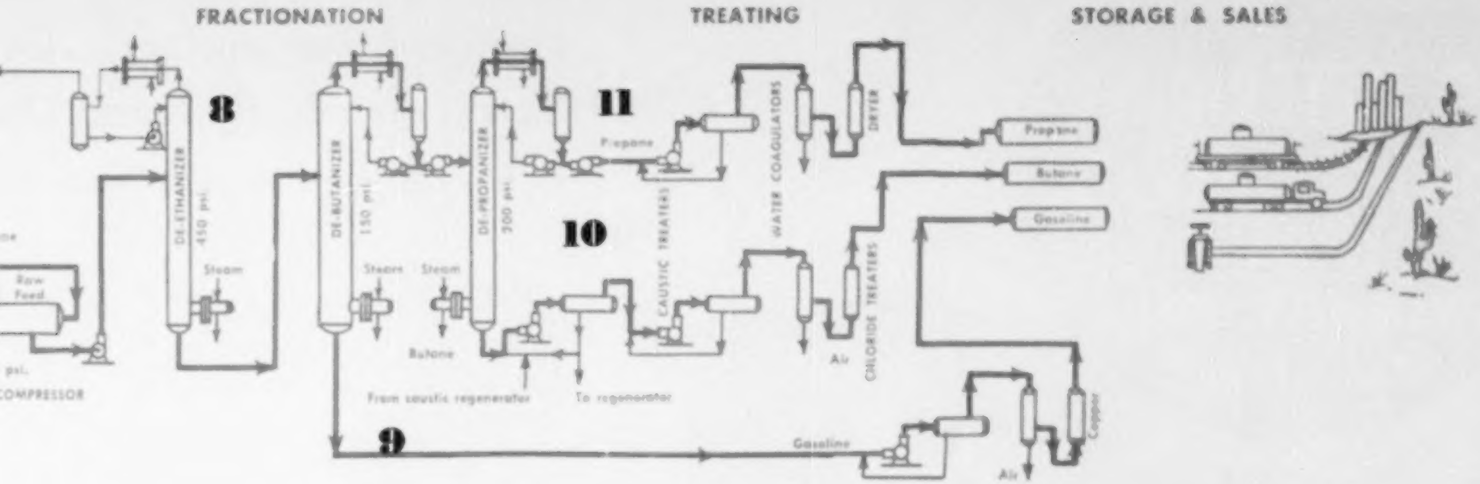


6 Rich oil heater is used to heat part of the oil to 500 deg. F.



7 Finned-tube condensers are are used to precool the overhead vapor which comes from the stripping still. Ethane removal is next.

8



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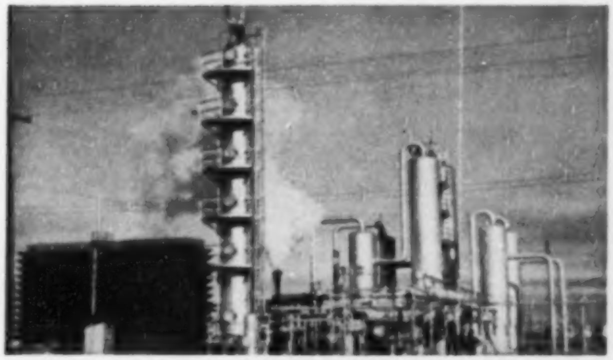
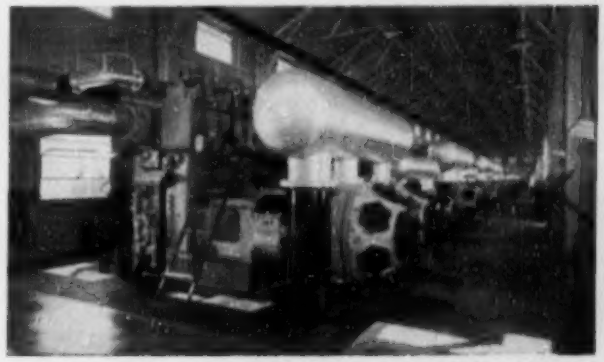
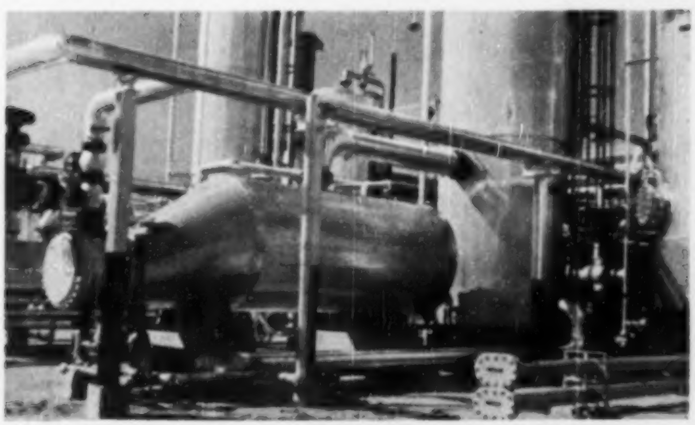


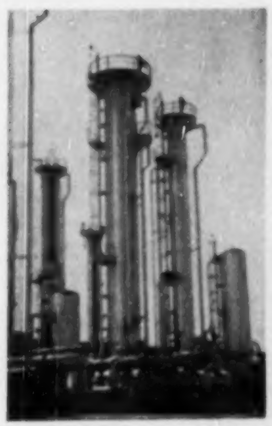
3 Desulphurizing unit takes the stripped gas from the absorbers. Here hydrogen sulphide is removed by means of ethanolamine treatment.



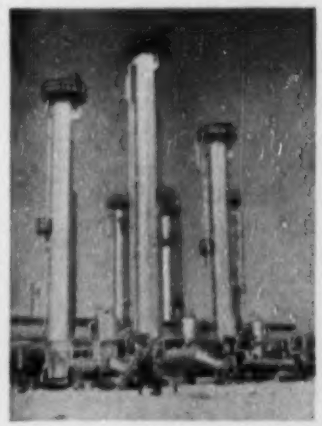
4 Compressors are a vital part of this plant's operation. Here are the high pressure and low pressure cylinders with receivers in the compressor house.



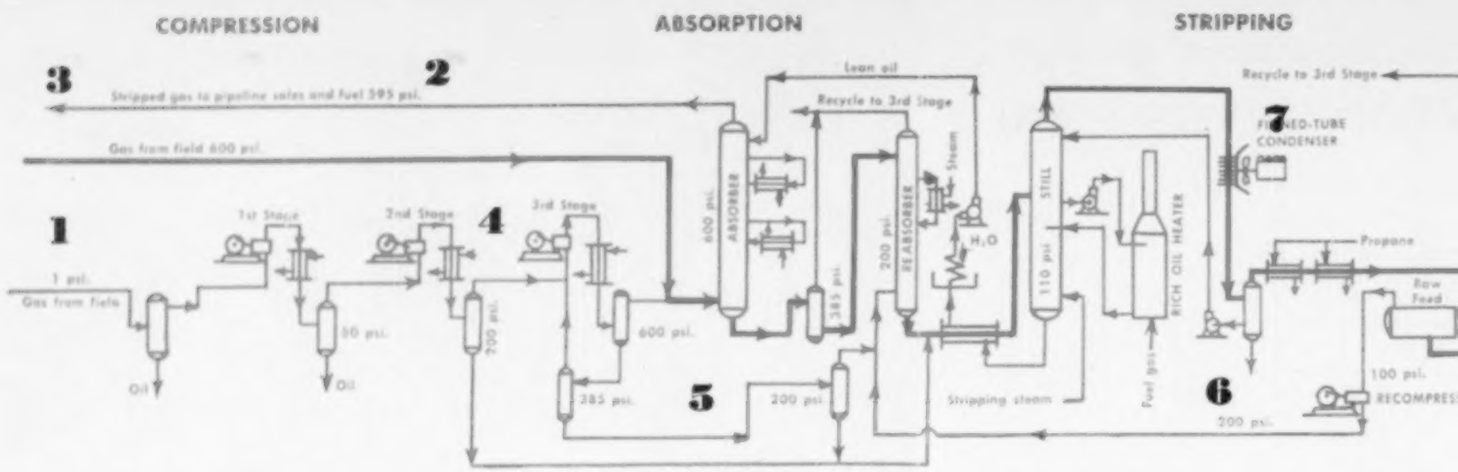
8 Fractionation units use aluminum sheathing for utility and beauty. Also shown here in the foreground is a typical reboiler used in the Kermit, Tex., unit.

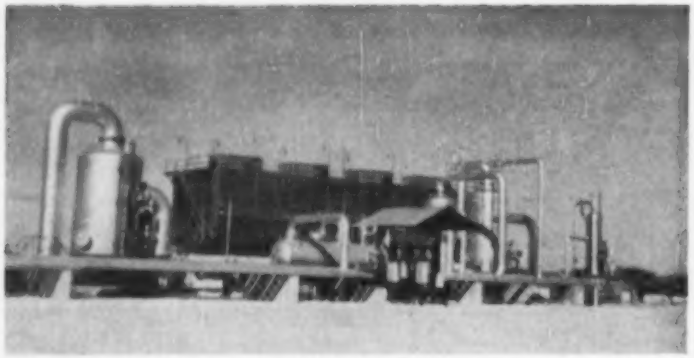


9 After ethane is separated butane and propane are cut out.



10, 11 Then propane and butane are separated in still.





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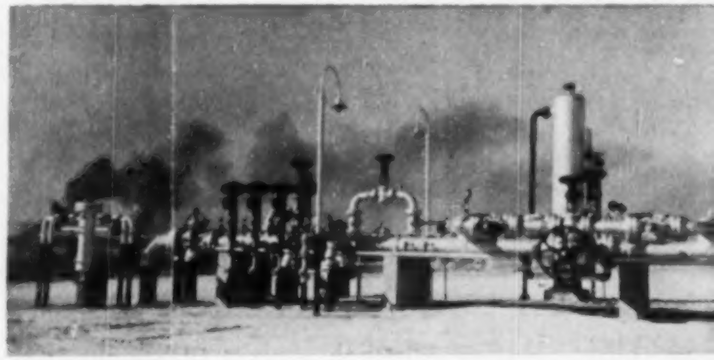

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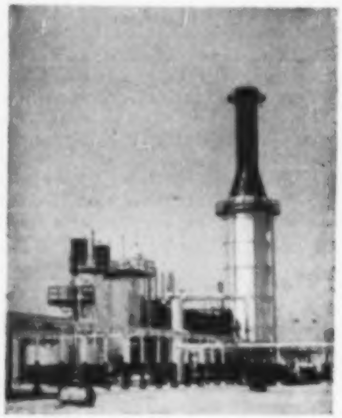

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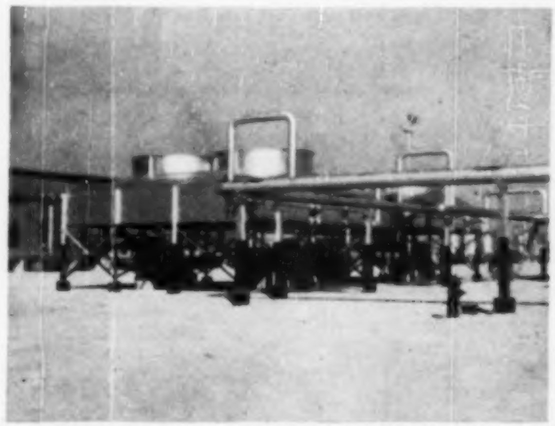

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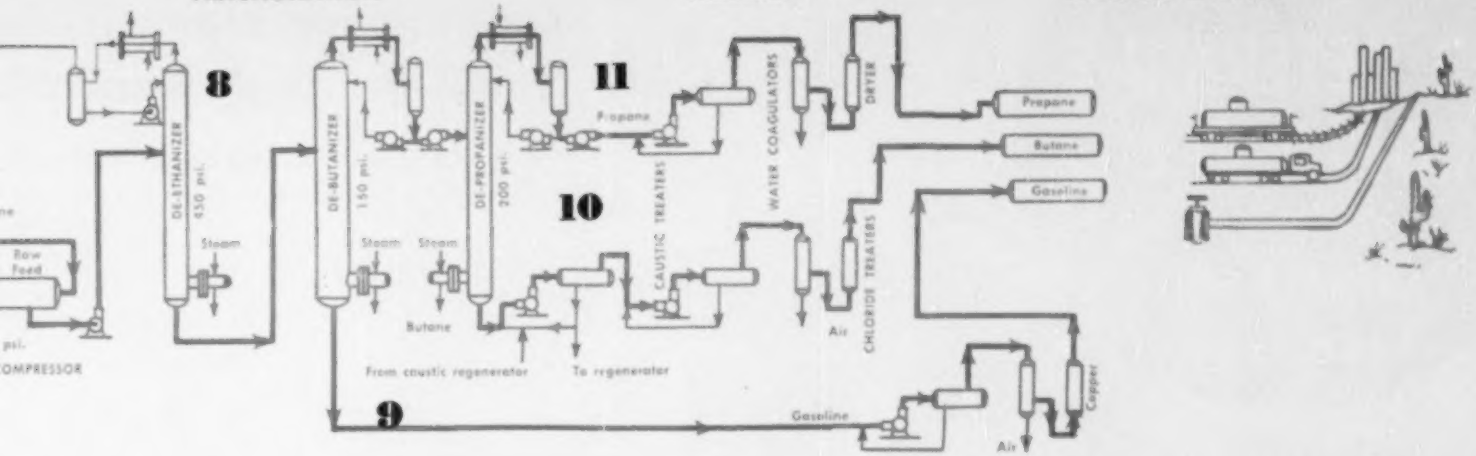
FRACTIONATION TREATING STORAGE & SALES



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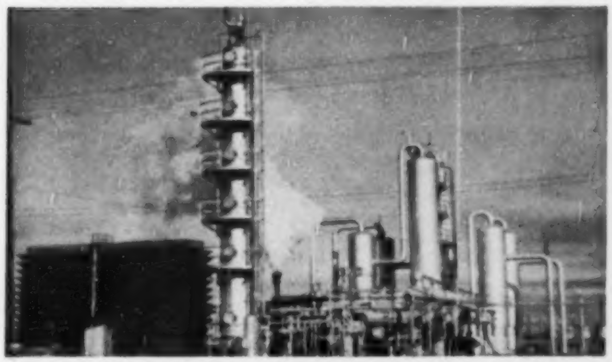

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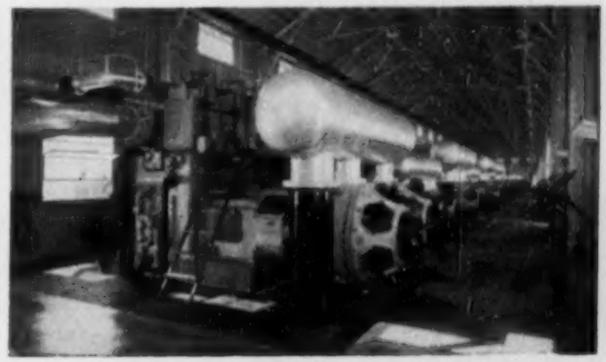

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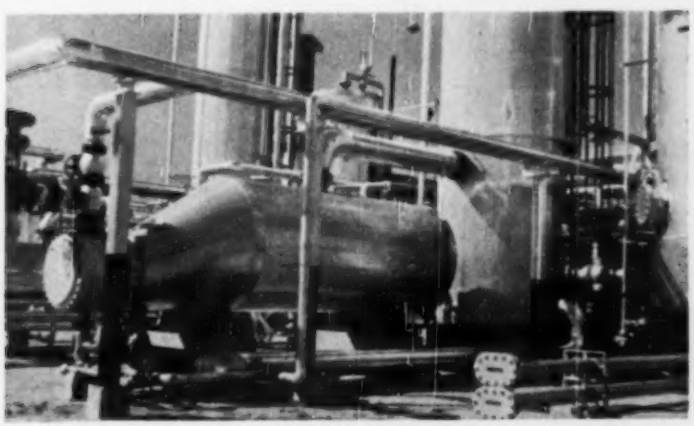

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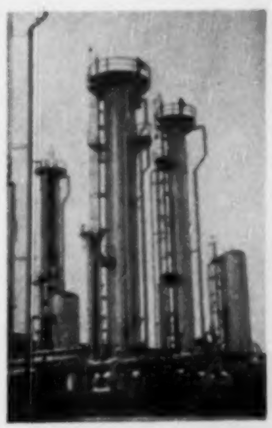

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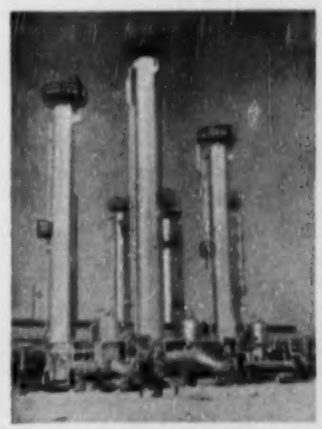

10, 11 Then propane and butane are separated in still.

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Only Tolhurst Variable Speed Centrifugals provide

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box. It's equipped with a packing spacer and
for proper lubrication of upper and lower pa
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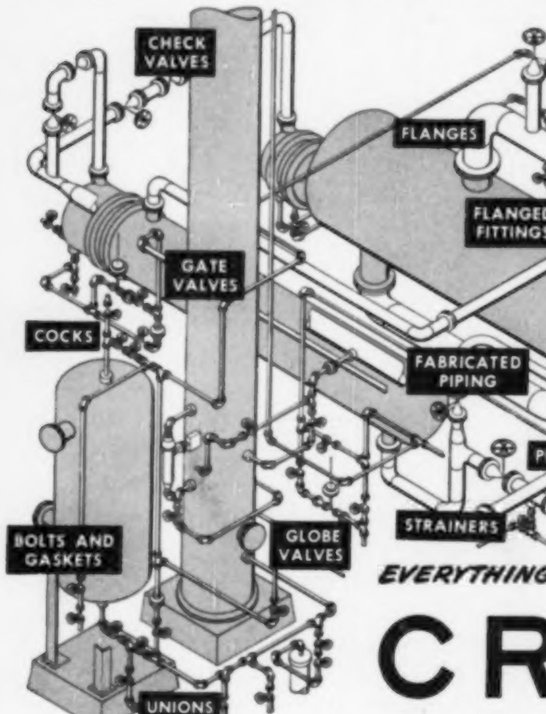

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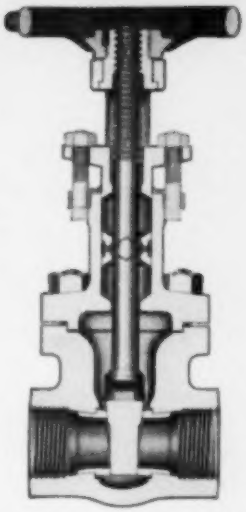

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ged, they combine many
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husky bonnet flanges.
gn minimizes danger of

tanding safety features.
tra long. Flanged end
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log, or send for folder

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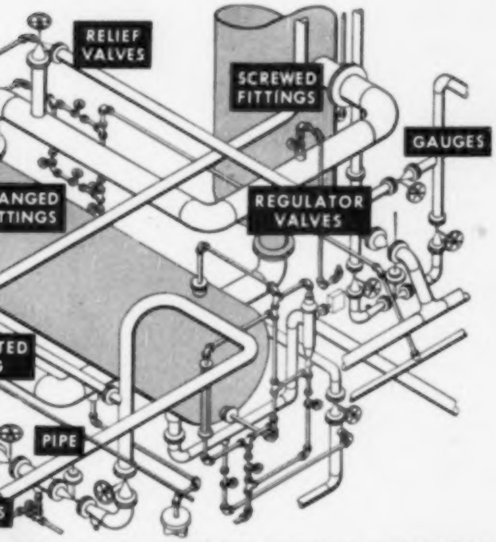
ll Industrial Areas

PIPING EQUIPMENT
R EXAMPLE



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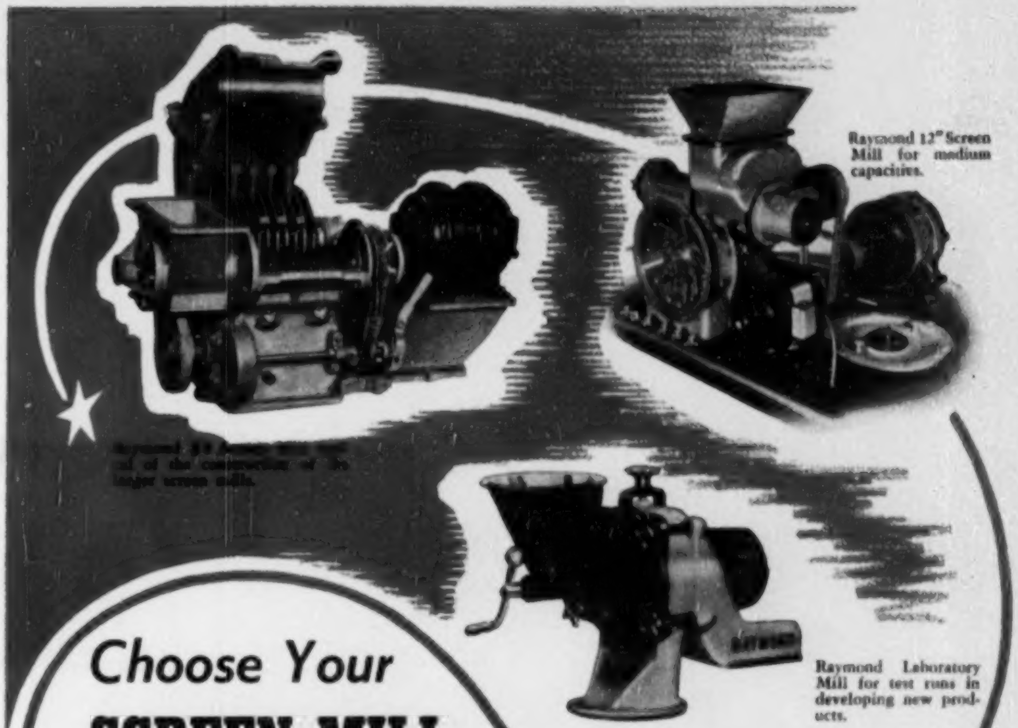

Raymond 12" Screen Mill for medium capacities.

[illegible] of the [illegible] of the larger screen mills.

Raymond Laboratory Mill for test runs in developing new products.

Choose Your
SCREEN MILL
from the
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Raymond builds a complete line of modern screen mills, ranging from the Laboratory Mill for very small batch grinding jobs to the larger production units available for capacities from a few hundred pounds to several tons per hour of finished product.

These machines are compact, self-contained units especially designed for pulverizing soft materials to medium finenesses. They find extensive application in the chemical, food, and process industries for the economical production of dry colors, food products, clays, drugs, and other various dry mixtures and products.

The Raymond Screen Mill is an acknowledged leader in producing powdered materials at a record low rate of power consumption. ***Write for bulletin No. 39B.***

Raymond Equipment includes Fine Grinding Units with Capacities up to 30 Tons or more per hour.

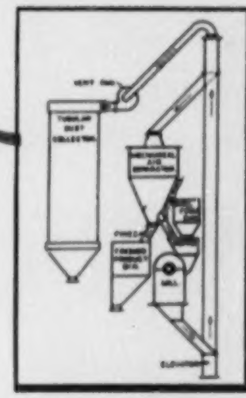

Diagram showing Screen Mill and Mechanical Air Separator in closed circuit for producing high fineness finished materials.

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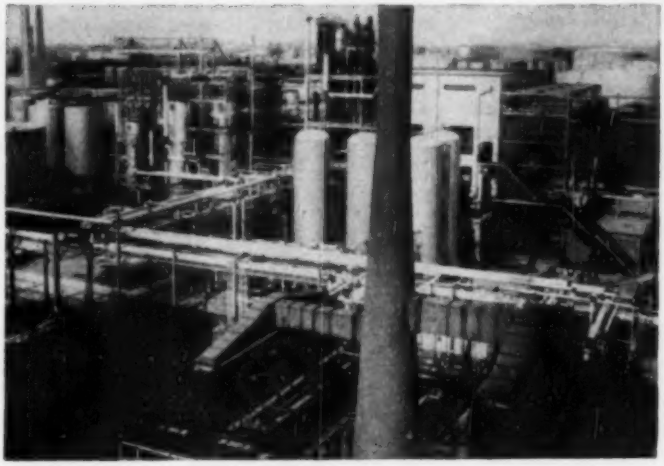
Chemical Engineering News

JOSEPH A. O'CONNOR, News Editor



Big Solvent De-Waxing Plant to Produce 178 Million Pounds of Wax a Year for Esso

A modern solvents de-waxing plant, which replaces with a continuous and automatic process the traditional manual wax-making operation, has been put on stream at the Bayonne refinery of Esso Standard Oil Co.

This new de-waxing unit, which is an MEK plant, will produce 178 million pounds of wax annually. It completes the latest general modernization of the 75-year old plant, the oldest in the Esso company and a specialty plant producing wax, lubricating oils and asphalt.

The modernization program includes the installation of a new boiler house and two new boilers capable of producing 400,000 lb. of steam per hour. Representing one of the most vital utilities in oil refining, output of the boilers would be sufficient to heat all the homes in the city of Bayonne.

Eliminating a process of wax-making that goes back to the earliest days of oil refining, the new plant will permit Bayonne to maintain its position as one of the foremost wax-producing refineries. In the past, wax was separated from chilled oil in plate and frame presses. Solidified wax was retained on canvas cloth filters and the wax cake removed by hand scrapers. De-waxed oil flowed beneath the press and was processed into lubricating oils.

In the modern operation, a waxy feed stock is mixed with a solvent composed of methyl ethyl ketone, benzene and toluene. This lowers the viscosity of the oil feed and accelerates the separation of wax from the oil. Rotary filters effect the actual separation.

MCA Plans to Intensify Its Program of Activities

Plans for greatly expanded, more aggressive trade association activities in the chemical manufacturing industries got top attention from 350 executives and other business leaders during two days of meetings at Spring Lake, N. J., in mid-June. The occasion was the 78th annual meeting of the Manufacturing Chemists Association and its joint outing and banquet with the Synthetic Organic Chemical Manufacturers Association.

First step toward a united industry was the overwhelmingly favorable vote for the consolidation of the Plastics Materials Manufacturers Association, Inc., with the Manufacturing Chemists Association, Inc. The PMMA, holding its annual meeting simultaneously in Massachusetts, quickly ratified the merger plans and its activities will shortly be integrated into those of the older Association. So far no progress has been reported on the proposed MCA-SOCMA merger, although both groups have liaison committees studying such a plan.

George W. Merck, in his presidential address, launched a broader program of public relations and related educational activities. He stressed the industry's urgent need for increased public awareness of its efforts and achievements in preventing air and stream pollution, improving its already excellent safety records and otherwise contributing to health and happiness. He presided at a panel discussion arranged by J. Handly Wright of Monsanto, chairman of the MCA Public Relations Committee. George R. Freyermuth of Standard Oil Company (N. J.) and chairman of the Oil Industry Information Committee of API, Glen Perry of the DuPont Company, and S. D. Kirkpatrick of McGraw-Hill outlined steps to be taken in organizing an adequate educational program. Appointment of Robert L. Taylor (see article and photo) to the newly created post of executive vice president was hailed as a significant step in this direction. Located in New York, he will work with Secretary Maurice F. Crass, Jr., in Washington and other officers in organizing and presenting MCA's work and objectives to its membership and to the public at large.

William M. Rand, chairman of MCA's Board of Directors, introduced Howard Huston of American Cyanamid and Sidney C. Moody of Calco. The former had just returned from Geneva and reported on the recent activities there of the International Labor Office. Moody, as president of SOCMA, told of the important tariff problems facing the industry, particularly in the possible loss of the American evaluation basis for determining import duties.

(Continued)

NEWS, *cont. . .*

Admiral Lewis L. Strauss, former member of the Atomic Energy Commission and president of the Institute of Advanced Studies at Princeton, N. J., urged better understanding of "atomic facts and fallacies" by industry. Major General Anthony C. McAuliffe, chief of the Chemical Corps, asked for continued teamwork, pointing out that anything that affects chemical industry has a vital relation to the national defense.

His Vinyl Dispersion Resins Win Hyatt Award for Powell

The John Wesley Hyatt Award for distinguished achievement in plastics has been presented to George M. Powell, III, technical head, Vinyl Coatings Research, Union Carbide & Carbon Corp., South Charleston, W. Va.

The Honorable John W. Snyder, Secretary of the Treasury, gave the presentation address.

Waldemar Kaempffert, science editor, *New York Times*, and a member of the John Wesley Hyatt Award Committee, made the award, a gold medal and $1,000 in cash, at a banquet at the Hotel Pierre in New York. A group representing the merchandising, banking, plastics and chemicals fields attended the ceremony.

The award was presented to Powell for his work in planning and directing the development, formulation and application of Vinylite dispersion resins. He was primarily responsible for the development of a method that makes possible the use of high polymers in high solids dispersions in combination with inexpensive thinners.

Charles A. Higgins, president of Hercules Powder Co., in a short talk described the rapid growth of the plastics industry, and also the contribution of small business to that growth.

Dean Richard F. Bach, Metropolitan Museum of Art in New York, served as toastmaster.

Powell's work enabled the plastics industry to enter the manufacture of products never before practical with materials usually associated with this industry. The toughest and least soluble of the vinyl resins can be used economically to coat cloth, paper, foil and metal, and also for inks, dip goods, elastomeric molded articles and unsupported films.

Vinyl dispersion resins are vinyl chloride acetate resins having a high chloride content. These resins have one important unique characteristic. Their sub-microscopic size makes it possible to disperse them in liquids and to obtain a high percentage of solids content. These extremely small particles then gather into a mass in which they are arranged in such a way

(Continued)

HYATT AWARD TO CARBIDE'S POWELL FOR WORK ON VINYLS

The Honorable John W. Snyder, Secretary of the Treasury, center, and Charles A. Higgins, right, president of Hercules Powder Co., which is the patron of the award, congratulate George M. Powell, III, winner of the ninth John Wesley Hyatt Award for distinguished achievement in plastics. Presentation took place in New York at banquet in Hotel Pierre. Powell, who heads vinyl coatings research for Union Carbide & Carbon Corp., was honored for his work on vinyl dispersion resins. He developed a method that makes possible the use of high polymers in high solids dispersions in combination with inexpensive thinners.

News, *cont.* . .

that they can be redispersed in either volatile or non-volatile liquids. After the dispersed particles are applied to the wire, sheet, glove, or whatever is to be treated, the resin is dissolved and fused into a continuous film by heating it.

The rapidity with which the dispersion resins have been adopted by industry is a measure of their worth. Although development work on them began in 1934, the material was not ready to be offered to industry until 1943, nine years later. By 1947, consumption had grown to 5 million pounds. Two years later the major

(Continued)

CONVENTION CALENDAR

Third Western Packaging Exposition, San Francisco Civic Auditorium, San Francisco, August 14-16.

National Association of Power Engineers, National Power Show, Hotel Jefferson, St. Louis, Mo., August 14-18.

Metal Mining Convention and Exposition, Fairgrounds, Salt Lake City, August 28-31.

American Chemical Society, 118th national meeting, Chicago, September 3-8.

National Chemical Exposition, Coliseum, Chicago, September 5-9.

American Institute of Chemical Engineers, regional meeting, Radisson Hotel, Minneapolis, Minn., September 10-13.

American Society of Mechanical Engineers and Instrument Society of America, Municipal Auditorium, Buffalo, N. Y., September 11-15.

Synthetic Organic Chemical Manufacturers Association, Commodore Hotel, New York, September 13.

National Petroleum Association, Hotel Traymore, Atlantic City, September 13-15.

Instrument Conference and Exhibit, Instrument Society of America, Memorial Auditorium, Buffalo, N. Y., September 18-22.

Drug, Chemical & Allied Trades Section, New York Board of Trade, annual meeting, Shawnee Inn, Shawnee-on-Delaware, Pa., September 21-23.

American Society of Mechanical Engineers, Petroleum Mechanical Engineering Conference, Roosevelt Hotel, New Orleans, September 25-27.

American Oil Chemists' Society, fall meeting, Sir Francis Drake Hotel, San Francisco, September 26-28.

American Coke & Chemicals Institute, Skytop Lodge, Skytop, Pa., September 27-29.

American Association of Textile Chemists & Colorists, The Wentworth, Portsmouth, N. H., September 28-30.

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If you shipped riboflavin—a widely used vitamin—the very thought of somebody dropping one of your shipping drums would give you gray hairs. A single drum of riboflavin is worth upwards of $10,000. But one of Continental's regular line of shipping drums—the Leverpak drum—is the choice of many companies for safeguarding their most valuable products.

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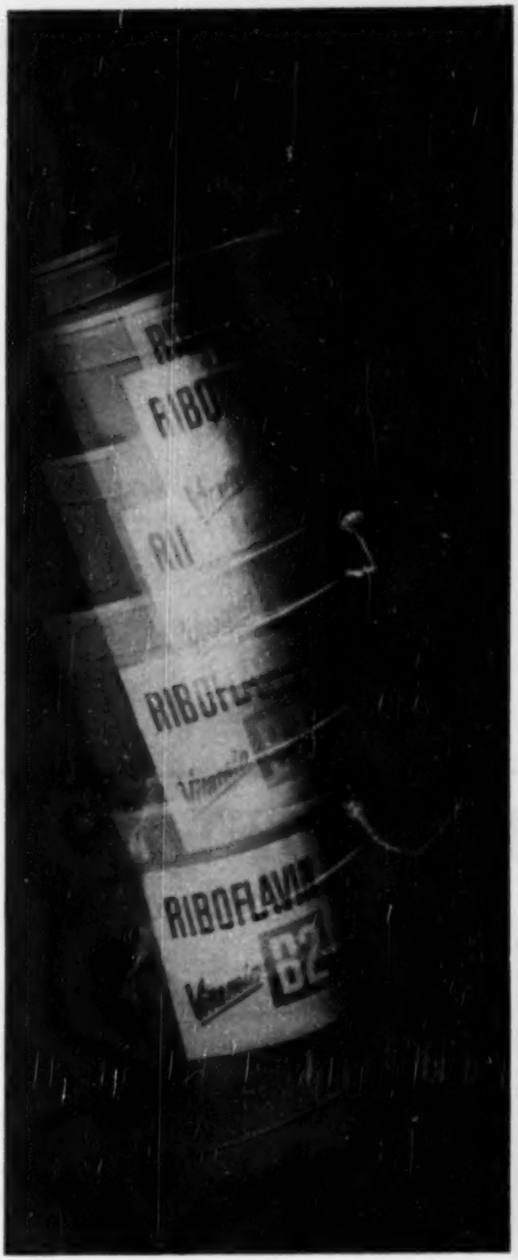

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production processes for finished articles had been perfected, and consumption more than tripled that of 1947.

Powell was born in Montgomery, Ala. After graduating from high school in Leonia, N. J., he entered Columbia College in 1927, receiving the A. B. degree in 1931. He then transferred to the School of Chemical Engineering, receiving the B. S. in chemical engineering in 1932, and the Ch. E. degree in 1933.

In that year also he joined Carbide & Carbon Chemicals Corp., and immediately engaged in research on surface coatings. He was made technical head of the Coatings Division of the Research and Development Department in 1944.

Powell is the recipient of the ninth John Wesley Hyatt Award, of which Hercules Powder Co. is the patron. The award was named to commemorate John Wesley Hyatt, "the father of the plastics industry." It was Hyatt's work with cellulose nitrate and camphor, in 1867, which resulted in the making of the first thermoplastic, celluloid.

The award has been presented annually since 1941 to the person judged by the Hyatt Award Committee to have made an outstanding contribution to the plastics industry during the preceding year.

The conditions which govern the selection of medalists are: the practicability of the achievement, its effect upon the plastics industry, its probable future value, and its degree of originality.

Members of the award committee are: Horace Gooch, Jr., president, Society of the Plastics Industry, Inc.; Dr. Charles F. Kettering, vice president, General Motors Corp.; Dr. Ernest Volwiler, president, American Chemical Society; Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research; Dean Bach; Dr. Felbeck, the 1948 medalist; and Kaempffert.

Kirkpatrick and Hochman Address Equipment Dealers

Dealers from all over the U. S. converged on New York last month for the meeting of the Process Equipment Dealers' Council held on Monday evening, June 12, at the Hotel Statler in that city. It was one of the best attended meetings of the year.

Chief speaker of the evening was Sidney D. Kirkpatrick, editorial director of Chemical Engineering and vice president of the McGraw-Hill Book Co. His topic was "The Used Machinery Dealer's Place in the Sun." Drawing upon his experiences as an advisor to government and private industry, Kirkpatrick cited the vital role played by used equipment during World War II and predicted limitless new vistas for the chemical industry. A question and answer period followed.

Ralph Hochman, former president of the National Machine Tool Dealers Association, discussed association problems that he had encountered during his wide experiences and told how they had been solved.

Presiding at the meeting was David M. Gold, executive secretary. The next dinner meeting of PEDC is scheduled for September.

Carbide Building New Unit To Make Polyethylene Resins

Bakelite Division, Union Carbide & Carbon Corp., announces plans for a new polyethylene resins plant at South Charleston, W. Va. The new plant is scheduled to be in full operation by the third quarter of 1951.

According to James W. McLaughlin, president of Bakelite, "These new

(Continued)

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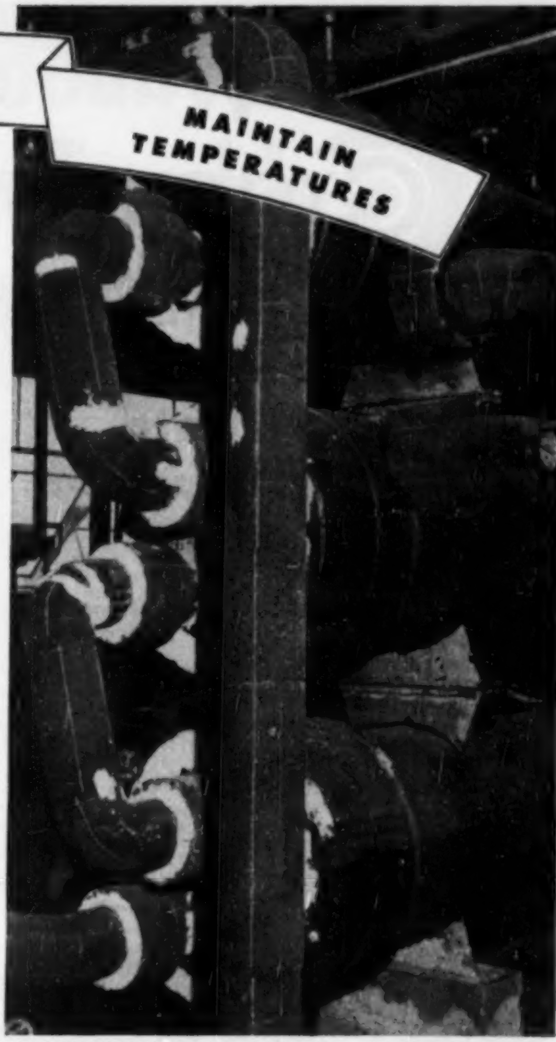


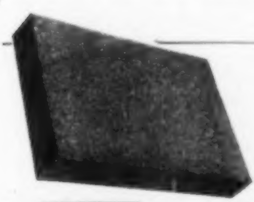
THIS PHOTO SHOWS how PC Foamglas is used to insulate process equipment and pipe lines. The material is available in standard flat blocks, curved segments and beveled lags to fit equipment sides, heads and domes, and in preformed sections for standard pipe sizes and fittings.

● It takes an effective insulating material to help maintain the exact temperatures needed for the continuous, efficient operation of process equipment. It takes a long-lasting insulating material to help keep maintenance costs down to rock bottom. More and more engineers and plant managers in the oil and gas, chemical and other processing industries have been installing PC Foamglas recently, because it meets both requirements.

The cellular glass structure of Foamglas makes it an exceptionally effective insulation. And, being glass, it has unusually high resistance to moisture, vapor, acid atmospheres and other destructive elements. The resultant freedom from repairs, maintenance and replacement makes Foamglas a truly economical insulation. When properly installed, Foamglas *retains* its original insulating efficiency.

You can get PC Foamglas Pipe Insulation in a wide range of standard sizes for indoor and outdoor piping. Covers of Foamglas for elbows, valves and other fittings can be procured from the factory, or quickly and easily fabricated in the field. For insulating tanks, towers and other vessels there are standard flat blocks of Foamglas, beveled lags and special shapes. Curved segments for heads and domes also can be obtained.

When you are figuring on insulation, make sure you have the latest information on PC Foamglas. You will find it in our newly published booklet, which contains descriptive text and photos of recent jobs, charts, tables, up-to-date specifications and installation instructions. Just send in the convenient coupon and you will receive promptly a sample of Foamglas and your free copy of the booklet.



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NEWS, *cont.* . . .

facilities will almost double the present production rate of Bakelite polyethylene and will help relieve the shortage of this versatile material."

The new plant, which will produce the basic resins from which the polyethylene plastics are made, is being constructed and will be operated by Carbide & Carbon Chemicals Division, Union Carbide & Carbon Corp.

"In the packaging field, polyethylene, flexible, non-breakable bottles, vials, and similar containers have found increased usage," McLaughlin points out. "Polyethylene bottles are currently being produced at a rate in excess of 65 million per year," he adds, "and it is expected that this production will be at least doubled by the end of 1950."

Economical methods have been developed for producing thin film from polyethylene by extrusion. The inert nature of the material, being nontoxic, tasteless, odorless, and possessing low moisture vapor transmission and excellent low temperature flexibility, makes it important in the packaging of foods. The film is also used for packaging small metal parts, soaps and chemicals.

GE Spending $1 Million On Taunton Plastics Unit

General Electric Co. is about to launch a $1 million improvement program to make the Taunton, Mass., plant of its Plastics Division one of the largest plastics operations in the country.

Plans are being made to alter nearly all interior sections of the Taunton plant and to modernize equipment for maximum production efficiency. Presses with the newest and fastest controls now known to the plastics industry will be added. Scheduled for completion about the end of 1950, these extensive alterations will begin this month.

The decision to expand and modernize the Taunton plant came at the close of a comprehensive study of the best means of speeding the growth of the GE plastics business. That location was selected because it has been producing both thermosetting and thermoplastic parts.

Manufacture of all molds used in plastics production at Taunton, Mass., and Decatur, Ill., will be consolidated in a larger and improved tool room at Pittsfield, Mass. The transfer of molding equipment to Taunton will also make room at Pittsfield for the eventual expansion of several chemical manufacturing activities. More

(Continued)

room may be needed there for molding silicone rubber, producing magnesium oxide, and for manufacturing plastic resins and compounds.

Robert L. Taylor

Taylor Gets New MCA Post Of Executive Vice President

Robert L. Taylor has been appointed to the newly created office of executive vice president of the Manufacturing Chemists' Association, Inc., it was announced by MCA President George W. Merck at the organization's 78th annual meeting held at Spring Lake, N. J., last month.

Taylor has been editor of *Chemical Industries*, a magazine published by Maclean-Hunter Publishing Corp. since 1943. He will take up his new duties Oct. 1.

Merck said Taylor will establish headquarters offices in New York later in the year. The present offices in Washington, D. C., will be maintained under the direction of Maurice F. Crass, Jr., secretary.

For the past 14 years Taylor has been engaged in publication and public relations work in the chemical industry. Following graduation in chemical engineering from the University of Michigan in 1936, he joined the editorial staff of *Chemical & Metallurgical Engineering*. After leaving this magazine two years later, he served as assistant to the director of advertising and public relations of Monsanto Chemical Co. He became editor of *Chemical Industries* in 1943.

He is a past chairman of the New York section and the public relations committee of the American Institute of Chemical Engineers, a founder and first president of the Junior Chemical Engineers of New York, immediate

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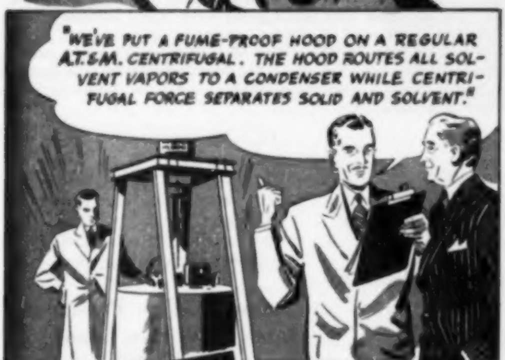

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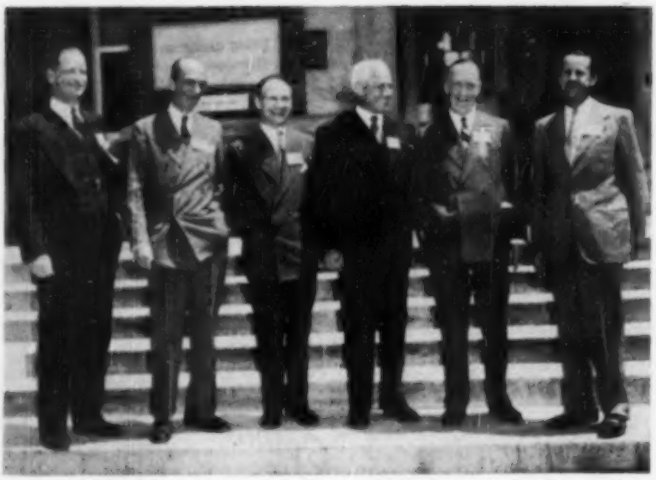

FAMED SCIENTISTS HELP DEDICATE NATIONAL DAIRY'S NEW LABS
President Lauren B. Hitchcock (far left) of National Dairy Research Laboratories and President L. A. Van Bomel of National Dairy Products Corp. (second from right) were ably assisted June 2 in dedicating the corporation's vast new research laboratories at Oakdale, L. I., by this panel of noted scientists and authors: Dr. Fairfield Osborn, president of Conservation Foundation and author of "This Plundered Plant" (second from left); Dr. Charles Glen King, scientific director, Nutrition Foundation; Dr. Karl T. Compton, chairman, Massachusetts Institute of Technology; and, at far right, Dr. W. Rupert MacLaurin, professor of economics, MIT, and conference moderator. Not shown but also participating prominently in this conference on world food and nutrition problems was Louis Bromfield, famous farmer, author and conservationist.

News, cont. . .

past president of the New York Business Paper Editors, and member of the American Chemical Society, American Institute of Chemists, Society of the Chemical Industry, Chemists' Club and Tau Beta Pi. He attended the atomic bomb tests at Bikini in 1946 as a representative of the technical press.

Koppers to Build Coke Ovens For Carnegie-Illinois Plant

Construction of two new coke batteries of 87 ovens each at Clairton Works of U.S. Steel's Carnegie-Illinois Steel Corp., replacing two batteries of old ovens, has been scheduled. Contract for the work has been awarded Koppers Co., Inc.

Actual construction of the first new battery is expected to get under way early in September, with work on the second starting about 60 days later. The batteries are scheduled to go into operation about one year after the start of construction work.

The new byproduct ovens will be of the underjet type, designed for coke-oven gas heating, with re-circulation of waste gases. The batteries will carbonize 5,000 tons of coal every 24 hr., yielding approximately 3,300 tons of coke in the same period.

Clairton Works contains 1,567 ovens which recover chemicals and gas during the coking of coal.

Chrome Yellow Production Starts at Willow Island

Medium chrome yellow pigment is now being manufactured by the Calco Chemical Division of American Cyanamid Co. in the recently constructed plant for its production of Calco's big Willow Island, W. Va., works.

This pigment was formerly made at the company's Newark, N. J., plant. In transferring operations to the Willow Island location, the process was modernized to embody the latest techniques in high-efficiency continuous operation. Construction was handled by Wilson Bros., a Parkersburg, W. Va., contracting firm. But all engineering work was done at Calco's Bound Brook, N. J., plant.

The chrome yellow plant constitutes the third unit of the Willow Island inorganic pigment group. The unit for the manufacture of iron blue was started in February 1948, and a second unit for the production of chrome green was added in October

(*Continued*)

1949. Facilities have been planned and space provided for further enlargement and expansion of capacity for this line of pigments. This large installation makes the Willow Island plant one of the principal sources of these inorganic pigments in the U. S.

Chrome yellow pigments are used in house and industrial paints, inks for magazine and carton printing, coloring crayons, paper and linoleum.

In addition to dyes and pigments, Willow Island produces folic acid, an important synthetic vitamin identical with the natural vitamin from liver; melamine resins for the textile, plastics and paper industries; and textile brighteners for use in soaps and detergents.

Tator Names Pierce to Head New Corrosion Subcommittee

The Technical Practice Committee of the National Association of Corrosion Engineers, in its recent meeting at St. Louis, created a subcommittee of Technical Practice Committee No. 6 on Protective Coatings to work on problems of corrosion protection by the use of chemical-resistant masonry constructions.

Kenneth Tator of Kenneth Tator Associates, Coraopolis, Pa., chairman of TP6, has designated this subcommittee as Technical Practice Committee No. 6K—Chemical-Resistant Masonry Construction, and has appointed Robert R. Pierce, product supervisor of the Pennsylvania Salt Manufacturing Co., Philadelphia, as chairman.

Rand of Monsanto to Get Chemical Industry Medal

William M. Rand, president of Monsanto Chemical Co., St. Louis, Mo., has been chosen to receive the Chemical Industry Medal for 1950, according to an announcement by the American Section of the Society of Chemical Industry, donor of the medal. The medal will be formally presented to Rand at a meeting of the American Section following a dinner in his honor at the Starlight Roof of the Waldorf-Astoria, New York City, on Nov. 3, 1950.

The Chemical Industry Medal was established in 1933 and is awarded annually in recognition of conspicuous services to applied chemistry. Rand, who is also president of the Manufacturing Chemists' Association, was elected to receive the medal by the executive committee of the Ameri-

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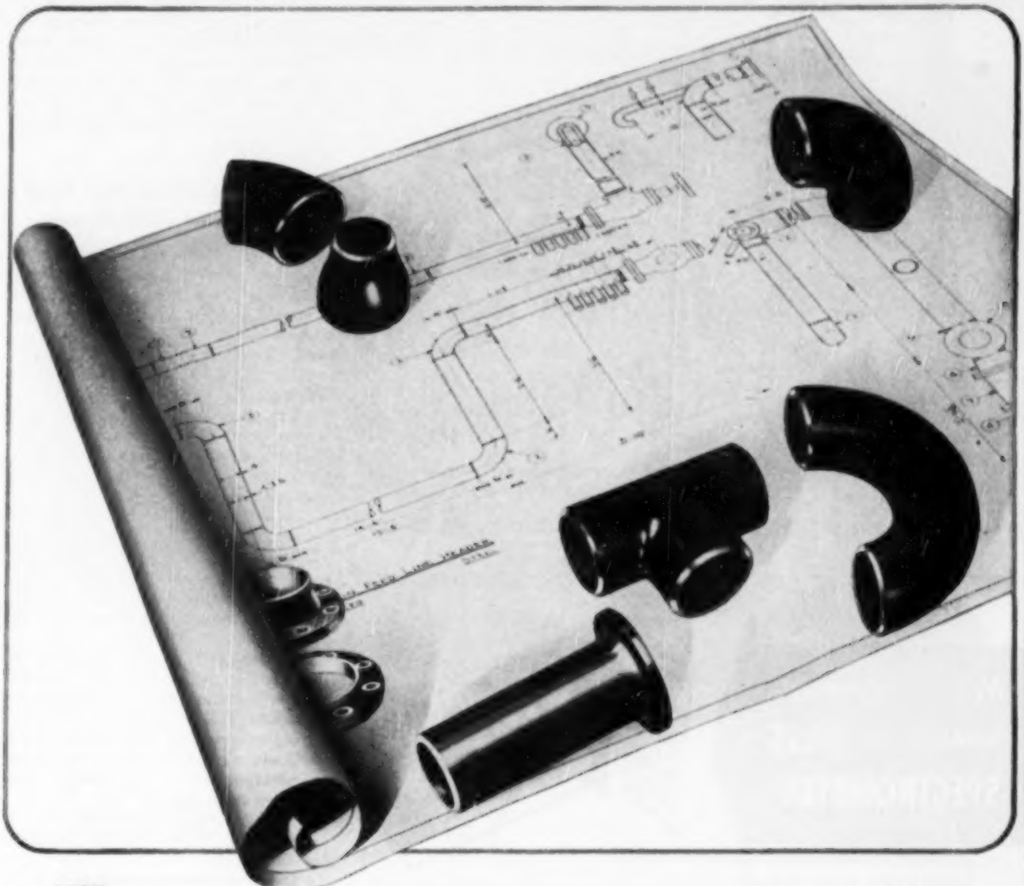
TO DO A BETTER PIPING JOB . . .



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can Section of the Society of Chemical Industry sitting as the Committee of Award.

Dr. Gustavus J. Esselen, consulting chemist of Boston, and chairman of the American Section, will preside at the award meeting, and Dr. A. J. Weith, of the Bakelite Division of Union Carbide & Carbon Corp., New York, and immediate past chairman of the American Section, will present the medal. Rand will be the seventeenth recipient of the Chemical Industry Medal.

AEC Plans Pilot-Plant Trial For New Chemical Process

The U. S. Atomic Energy Commission has authorized construction of a $500,000 pilot plant for chemical processing at the Wabash River Ordnance Works in Vermillion County, Ind. The announcement was made by Carroll L. Wilson, AEC general manager.

A small part of the space in the ordnance plant now is occupied by the commission, but the existing facilities have been in standby since 1945 and are outmoded and inefficient.

If the pilot plant process proves successful, the commission will modify the rest of the space or install new facilities at the ordnance plant. Renovation of these facilities and installation of new equipment are expected to cost about $5 million.

Construction of these facilities, if undertaken, will begin this summer and will require 18 to 20 months to complete. It is estimated that the construction program will require about 800 men. Operation of the plant after completion, however, will call for less than 30 employees.

Girdler Corp. of Louisville, Ky., is completing studies on the feasibility of the process.

In making the announcement, Wilson stated that no radioactivity will be involved in the operations at the Wabash River Ordnance Works. The project, he added, is under the supervision of the New York operating office of the AEC. Further details of the project are not available now.

Florida Paper Mill Doubling Capacity at $10 Million Cost

Hudson Pulp & Paper Corp. plans construction of a $10 million addition to its plant at Palatka, Fla., it has been announced by Governor Fuller Warren and the corporation. Work on the addition is to start in the immediate future.

(Continued)

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No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
Non-pulsating pressure.
Original performance constant over a long pump life.
Low maintenance cost.

NASH ENGINEERING COMPANY
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William Mazer, executive vice president of Hudson Pulp & Paper, states that the expansion will double capacity of the Palatka plant and provide employment for 750 more persons, raise its annual payroll from $2 million to $4 million, and contribute another $1.5 million to the state's economy through purchase of additional raw materials.

Last year the company produced about 63,000 tons of kraft paper.

Merck Takes Over Cherokee Ordnance Works from U. S.

Merck & Co., Inc., has concluded an agreement with the Department of the Army for a 15-year lease and eventual purchase of the government-owned Cherokee Ordnance Plant near Danville, Pa.

Negotiations were completed when an Army representative signed the agreement in Washington, D. C. The company will use the plant to manufacture medicinal chemicals and fine chemicals for industry.

The Cherokee plant has been idle since the end of World War II and has been maintained by the government on a standby basis as part of the preparedness program.

The Army-Merck agreement will relieve the government of the cost of maintaining the plant, which is believed to amount to about $100,000 a year, while providing for quick reconversion to wartime uses in the event of a national emergency. Merck will assume the burden of maintenance and, in addition, will pay a yearly rental of $30,000 for that portion of the plant that it plans to use.

Lease will expire Dec. 31, 1965. The company has an option to buy certain sections of the plant during that time and will purchase the remainder at the end of the period. The government will retain title to part of the plant while the lease is in effect, in case it again becomes necessary to use the facilities to produce war materials.

Merck expects to be able to start production at the Danville location next spring, and meanwhile will spend more than $1 million to convert part of the facilities, install new equipment, and maintain the rest of the plant for the government.

Cherokee Ordnance Plant was built and operated for the government during the war by the Heyden Chemical Corp. It was used to produce chemicals for the war effort.

The property consists of 93 acres lying partly in the Borough of River-

(Continued)

NEWS, cont. . .

side and partly in the Township of Gearhart, a mile and a half below Danville on the north branch of the Susquehanna River. Facilities include 19 major buildings and a number of smaller structures, plus a power plant, storage tanks, settling basins, and other installations.

The company's other manufacturing plants are at Rahway, N. J. (company headquarters), Elkton, Va., and Philadelphia. A Canadian subsidiary, Merck & Co., Ltd., conducts manufacturing operations at Montreal and Valleyfield, Quebec.

Foote Mineral Trims Prices On Its Lithium Compounds

Price reductions up to 10 percent, effective July 1, 1950, are announced by Foote Mineral Co., producers of lithium compounds used extensively in all-purpose greases, ceramics and porcelain enamels, air conditioning, welding fluxes and many chemical products. Direct savings from newly developed processing techniques make possible this action.

L. G. Bliss, manager of sales, states, "These savings in manufacturing costs are being passed on to users of lithium as a continuing policy of the company. In the past decade, the cost of many lithium compounds has been halved. As additional segments of our long-range research are reduced to commercial practice, further price reductions will be made."

Hypersorption unit to be built by Foster Wheeler for Dow Chemical Co. will be Dow's second. The new unit will have a charging capacity five times that of the first unit, which has been operating successfully since June 1947. Three pure product streams; namely, C-1's and lighter from the top, C-2's as the middle cut, and C-3's and heavier as the bottom fraction, will be separated from the cracking plant effluent.

Anhydrous ammonia, increasingly popular as a fertilizer for row and forage crops on the Gulf Coast, can now be used successfully in tung orchards. This is a result of engineering research recently completed by the Mississippi Experiment Station. The station has designed equipment that will place and seal anhydrous ammonia in the soil where the tung trees grow.

Vat dye production has been started by Tennessee Eastman Corp., Kingsport, Tenn., with jade green the first offered. A complete range of vat dyes will soon be in production. TEC says it is the only manufacturer of vat dyes in the South. The company has done research and experimental work on the application of vat dyes to viscose and acetate rayon fabrics.

New vinyl plant to be built and operated by the Carbide & Carbon Chemicals Division of Union Carbide & Carbon Corp. at South Charleston, W. Va., will be running by mid-1951. The plant will employ entirely new and different production methods. It will produce Vinylite resin VYNV-3, which has been made on a pilot-plant scale for about two years. This dispersion resin makes possible improved plastisols that speed up production. *—End*

READERS' VIEWS AND COMMENTS

Who Does Pay?

To the Editor:

Sir:—I think I am looking at the problem of your May editorial (p. 102) "Who Should Pay?" from a slightly different angle. I think the question is "Who *Does* Pay?" and the answer is: the worker himself pays all of it. *He* pays, it seems to me, either his own or his neighbor's.

We have become so accustomed, in twenty years of New Dealism, to the idea that the "Company" is paying half the unemployment and old age benefits, that we think the company pays or can pay everything—all sorts of benefits. Actually, the "Company" pays nothing—the "benefits" are simply elements of cost and are therefore included in the purchase prices we all pay for everything: food, clothing, housing, entertainment, etc. (wherever social security taxes are applied).

What disturbs me is the nationwide acceptance of the something-for-nothing philosophy and the almost total destruction of individual initiative and personal responsibility. I feel that something-for-nothing thinking is at least partly responsible for many other difficulties, e.g., increase in gambling, more crime-and-politics,

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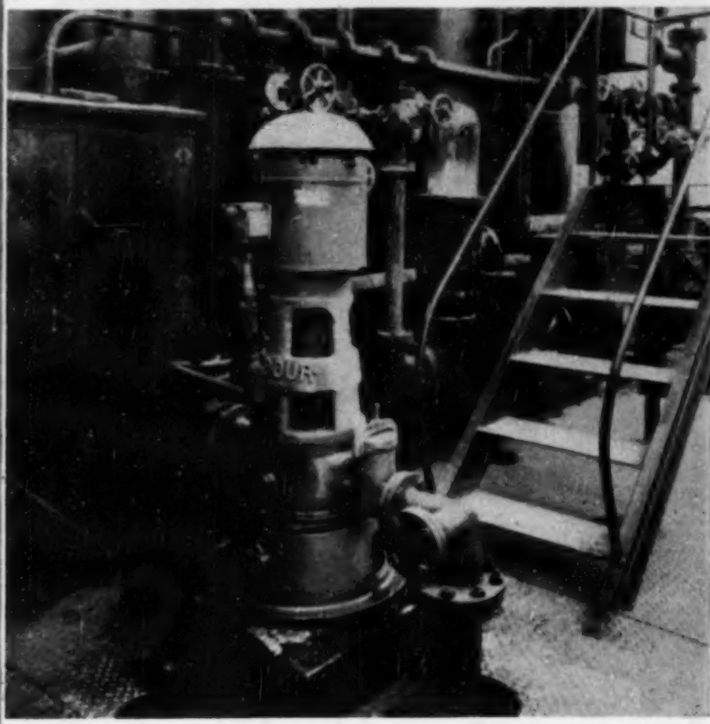
they specified LaBOUR



Here's a No. 10 LaBour Type G at work in a Chemco contact sulphuric acid system. The owners of this plant wanted dependability—freedom from costly process interruptions due to pump failures—and they got it when a LaBour was specified for the job.

LaBour Type G is the packingless, self-priming centrifugal pump that has revolutionized old concepts of pump maintenance. Since it has no packing gland, it never needs attention for tightening or repacking. There are no rubbing or wearing parts anywhere in this pump, and aside from occasional lubrication of the bearings there's nothing to do to keep it working properly. That's minimum maintenance at minimum trouble and expense.

If you aren't already familiar with the overall economy and process efficiency which a LaBour Type G can deliver, we urge you to write for full details. If you'll tell us the facts about the particular job you have in mind, we can give you specific information that may be of great value to you.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

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more complacence generally regarding graft in government, etc.; and it facilitates the making of brazen demands by labor leaders without arousing any resentment in the general public.

To return, however, to the problem of social security (old age, unemployment, medical—the whole works), I believe that since we all pay the cost of it anyway, it should be set up as a compulsory insurance. Everyone would "then realize first the cost and then the value" and each could thus feel some pride in providing for himself. Incidentally, the cost would be less because a large part of the social security bureaucracy would be eliminated since the collection would be made as payroll deductions, and because the accounting would be handled honestly instead of by the phony bookkeeping in Washington wherein no one knows whether or not social security is solvent. Once a compulsory insurance law was passed, the thing would be out of politics and out of labor deals.

We have a situation wherein everybody is being subsidized and everyone is being taxed to support everybody. In theory a welfare state isn't far from Communism. It seems to me that there are some indications that the time is about ripe to call a spade a spade. "Engineers and executives of chemical enterprise," at least those who read *Chemical Engineering*, can, in talking with the "men in the plant," help insure that they are "properly informed as they can be." The man in the plant, in my experience, is eager to listen to an engineer who is at all human.

P. B. KIMBALL
Boston, Mass.

We Fell Into Our Own Trap

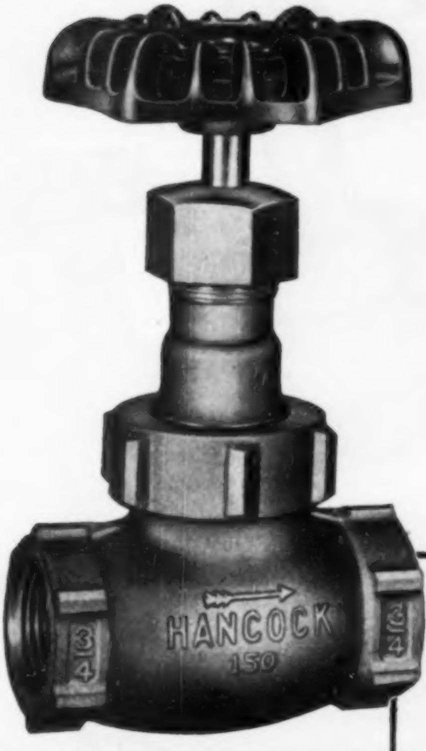
An article in our February issue entitled "Supply and Demand" discusses sulphur activity. Unfortunately, the paragraph entitled "More From Fuels" (p. 97) might be read to mean that the Worland plant of Texas Gulf Sulphur produced 70,000 tons in 1949 as compared with 16,000 tons less in 1948.

Our March issue misinterprets the February issue in just this way. Under the photograph (p. 177) we refer to the fact that Texas Gulf Sulphur produced 70,000 tons in 1949 against 16,000 tons the precceding year.

The facts: Total sulphur from fuel gas was 70,000 tons, 1949; 54,000 tons, 1948. Construction at the Worland plant was not started until 1949 and operations began on April 8, 1950. —*End*

ANNOUNCING!

The New 150# Hancock "500 Brinell" Bronze Valve

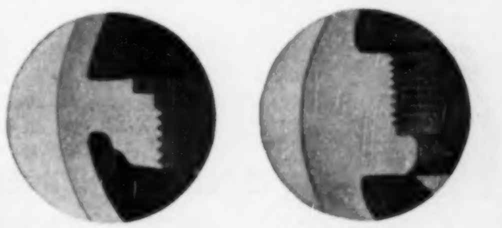


300# Valve Results at 150# Valve Prices!

"Super-Tough" is the word for the new 150# Hancock "500 Brinell" Bronze Valve. With a diaphragm construction equal to a 300# bronze valve, real strength and rigidity are built into this new bronze valve. Super-finished "500 Brinell" stainless steel seats and discs prevent leaks, cut maintenance cost to a minimum. Note the extra-rugged structure that means top ability to withstand expansions in piping systems, strains from installation and piping. Save money, increase efficiency, stop leaks. Install new 150# Hancock Bronze Valves.

For complete information, see your local distributor

Diaphragm construction of new 150# Hancock Bronze Valve 125% to 230% stronger than found in usual bronze valves



Usual bronze valve diaphragm

Hancock diaphragm

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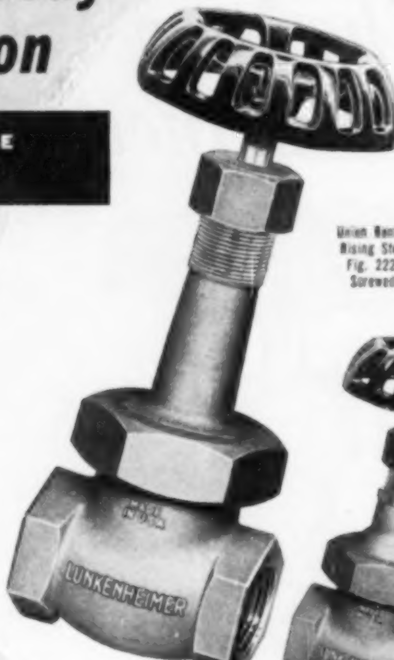
The cylindrical body defies distortion

LUNKENHEIMER FIG. 2228 LINE
UNION BONNET GATE VALVES



Union Bonnet
Rising Stem
Fig. 2228
Screwed

Union Bonnet
Non-Rising
stem
Fig. 2230
Screwed

In this design of 200 lb. S. P. Bronze Union Bonnet Gate Valves, Lunkenheimer incorporates the first application of full cylindrical body sections in bronze gate valves. This construction, previously used only in higher pressure steel valves, provides great strength and maximum resistance against distortion of the valve body and seats due to internal pressure strains and other stresses. Tests made under conditions far more severe than those encountered in actual service prove that this design will not distort and will maintain initial proportions and seat tightness.

In addition to the cylindrical body construction and other service-giving features, the valves are equipped with stems made of the distinctive silicon bronze alloy developed by Lunkenheimer to eliminate stem-thread failure due to wear.

Your Lunkenheimer Distributor will gladly show you how this valve's extra strength means extra service, extra value, too! Ask for Circular 534 or write direct.

O. S. & Y.
Union Bonnet
Rising stem
Fig. 2232
Screwed

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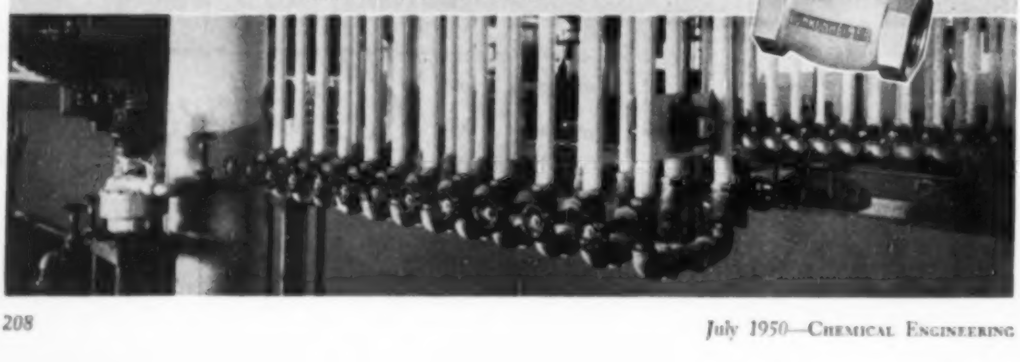


The Human Equation

RICHARD L. DEMMERLE, Associate Editor

Industry Is Sold on the Men Who Buy

A few years ago the alumni association of a large midwestern university was holding a testimonial dinner in honor of its conference champion football team. As after dinner coffee neared the bottom of cups the toastmaster introduced the members of the team's "dream" backfield which contained a high population of All-America candidates. Each said a few words but took fifteen minutes to say them. The quarterback explained that his brilliance in calling plays would have amounted to naught if it had not been for the spectacular running and passing of the halfbacks. The latter in turn complimented the piledriving fullback, the menace of whose surges made it possible for them to be free to look "great." This last shrinking violet pushed himself up from his eclair and summoned strength to wax eloquently upon the coaching talent that had made the team's record a reality.

Then, as a gesture to democracy in sports, the toastmaster asked the team captain, a lowly lineman, to rise and be heard. He did rise and was heard as he turned to the backfield end of the table and said: "Wouldn't you guys look silly—running, kicking, passing, dodging and blocking—and in front of 70,000 spectators—if the center didn't pass the ball back to you?"

It may be reaching for an analogy but the above incident seems to serve well to illustrate the position and importance of the industrial purchasing agent. The quality of the raw materials and equipment he buys makes the task of the production man easier. And the economies he effects in buying them put his company's leading ground gainer, the salesman, in a better position from which to score.

Like the center on the football team, the purchasing agent's performance is often taken for granted. His good moves are rarely applauded and condemnation is quick to be dumped upon his head if material arrives a day late or of a quality inferior to that requisitioned by the plant. About half the time such mistakes should be chalked upon against the supplier but the purchasing agent, being closer at hand, usually bears the full brunt of the outraged plant manager's wrath.

Perhaps the unkindest cut of all to the P.A. is to hear himself described as a penny-pinching dyspeptic grouch who breaks down his sales resistance and places an order only when the firm is on the verge of shutting down operations for want of raw materials. His personality, these critics claim, is akin to that of a rattlesnake with a toothache and his diet is supposed to consist of salesmen who are first paralyzed by the horror of his icy leer.

Any lingerings of this impression, if ever founded in the past, are quickly dispelled by a visit to the office of a modern industrial purchasing agent. Visitors, salesmen included, are welcomed by an interested management minded executive, well acquainted with his company's operations. The warmness of the reception may indeed cause the guest to glance at the lettering on the door to make sure that he has not wandered into the sales department by mistake. Another reason for confusion on this score is the fact that several men in major purchasing positions are ex-salesmen. Conversely, many successful salesmen give due credit for their success to the years they spent on the drawer side of a purchasing desk.

A cheap purchase is money lost
Japanese Proverb

The most surprising thing to be observed during a sales interview with today's P.A. is that the question of prices may arise only late in the first conversation with him, if at all. The dollar sign must stand in line behind questions about the product's quality, properties, uses, and long term availability.

To this end industry now hires and develops engineers and other technically trained men for purchasing positions. George A. Renard, executive secretary of the National Association of Purchasing Agents, revealed to this column that an estimated 40 percent of major purchasing posts are now held by men with engineering training or experience. "This," he said, "represents a fourfold increase over the percentage figure of 20 years ago—and it must be remembered that during the last 20 year period the total number of people in the field of purchasing has tripled."

The priority and scarcity ridden days of World War II made many previously unconvinced chemical managements see the value of having technical men do the buying job. The technical P.A., completely familiar with the needs of the process or plant for which he was buying, was able to accept or reject available substitute materials on-the-spot, without constant recourse to the plant manager for decisions.

In the years since the war several chemical process companies have adopted semiformal programs for the development of technically trained purchasing agents. Young engineers, directly out of college or with previous industrial experience are put on a planned junket through several of the company's plants. The aim is to familiarize them with the needs of the individual plants, but more important, to allow them become acquainted with the various plant managers with whom they must later work on a team basis.

In this circuit of the company sites the P.A.-to-be spends a tour of duty in the research of development laboratories of the company. Here the neophyte sees processes in the making and begins to realize the importance of anticipating the material and equipment demands of a process long before it reaches a commercial scale. Just as in his plant assignments, the stay at the research laboratory serves the other vital purpose of giving him a chance to meet and work with the men whose ideas and activities can only be implemented by the supplies he procures for them.

The business end of purchasing is unfolded to the trainee during a period of indoctrination in the home offices of the company. Accounting procedure, insurance regulations, contract legalities, traffic operation, inventory control and market analysis are only some of the topics he must master before he may be considered for his initial purchasing assignment.

(Continued)

The chemical process industries can claim a rightful place along with the automotive, metal and electrical industries as forerunners in this field of purchasing-engineering. In fact it can be said that sooner or later the purchasing department of a major chemical process company is concerned with the technical properties and commercial aspects of every raw material and every finished product in all of industry!

> **The buyer needs a hundred eyes . .**
> *G. Herbert's Proverbs, 1639*

To provide the versatility yet specificity of training and experience required to tackle this immense job, most central purchasing departments in the CPI consist of specialized buying divisions each devoted to a given classification of raw material or equipment. These divisions are frequently subdivided into smaller groups concerned with the procurement of major items that fall under the divisional heading. "Basic Raw Materials," for instance, is a typical division title, but individuals or groups working in this division will be charged separately with the purchase of phosphate rock, limestone, salt, coke, etc.

Individual divisions are headed by men with previous operational experience, a technical degree, or both. Modern purchasing practice often puts chemical engineers in charge of the "Basic Raw Materials" and "Chemicals" divisions, a mechanical or a chemical engineer in charge of the "Process Equipment" division, and an electrical engineer at the head of the Electrical Equipment" division. Specialists in their fields are also found leading the divisions concerned with "Plant Maintenance and Mill Supplies," Laboratory Equipment and Supplies," "Materials Handling" and "Salvage and Reclamation."

The "Services" division of a CPI purchasing organization is concerned mainly with negotiations for outside services, such as construction work, the fabrication of special process equipment and the like. Invariably this division is headed by a man with broad engineering training and experience.

The organization of purchasing in most companies in on what is often termed a "centralized-decentralized" basis. The bulk of the buying is done by the central purchasing office but various large plants or operating division of a company are often provided with purchasing groups of their own.

(Continued)

The latter are usually given considerable freedom in their mode of operation but they must hew to the line of purchasing policy formulated in the central office. Bnt in matters of administration the head of a branch purchasing office is responsible directly to the plant manager or the divisional superintendent, as the case may be.

There is more to modern purchasing, however, than a well organized buying network. The efficient purchasing man must keep abreast of plans and activities within his entire company if he is to function with foresight. Production, management and even sales conferences include him as a welcome member and his observations on commodity trends and markets often become the groundwork for future company-wide planning.

In return these conferences provide him with the information he needs to shape his buying program. Is labor trouble at Plant A going to force a shutdown? Is the raw material inventory at Plant B too large to carry economically? Will new local anti-pollution legislation make it necessary to buy and install smoke control equipment at Plant C?

The outside world also commands a good portion of the purchasing agent's attention. One P.A. recently told the writer: "Reading a newspaper may be relaxation to some people but to me its just asking for worry. The news report of a flood, fire, explosion, or a strike in an industrial area means a sleepless night—and the early fragmentary account of a train wreck makes me dread showing up at the office the next morning."

Ken when to buy.

Scottish Proverb

The salesman's presentation of data about a new material or piece of process equipment is carefully weighed by the technical P.A. If he finds it holds promise the data are forwarded to a special group in the engineering or research department that works in close liaison with the purchasing department on the investigation of new products and equipment units. If this laboratory group agrees that the suggestion has merit, a sample of the product or device will be obtained and put through its paces. The test run report enables the P.A. to recommend to the production department whether or not the proposed item should be considered for use in the plant.

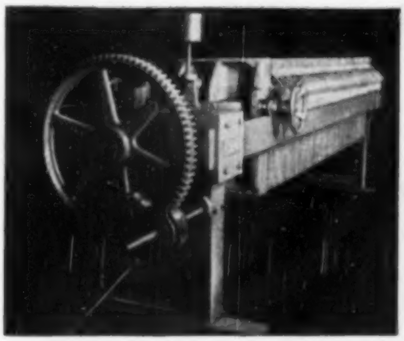
The commodity picture of the industrial world is presented to the

(Continued)

Dollar for dollar... the most efficient process of filtration

SPERRY FILTER PRESSES

The plate filter press, as built by Sperry, is today's most widely used filtration equipment. Why? Because the process industries have learned through experience that this type of equipment offers the greatest dollar value.



Consider what the Sperry filter press will do. It handles *any* filterable mixture, including viscous, and produces maximum clarity with the driest cake. The cake, thoroughly washed, is delivered in slab form ready for the drier trays. These presses will perform low, medium or high pressure filtration under precise temperature control, and will handle hot liquids without vaporizing. The liquid need not be exposed to the atmosphere.

Now, consider the cost. Simple construction means minimum first cost and minimum cost of installation. The simplest filter cloth and paper may be used, just as it is cut from the roll. Operating expenses are minor since unskilled labor may be employed. And maintenance is negligible. There is little depreciation, and because of the wide use of Sperry filter presses, they are easily resold if your processing plans no longer require filtration.

Sperry filter presses are available in a wide range of styles and capacities, equipped with a variety of different closing devices to suit your operation perfectly. Whether your product calls for the filtrate or the cake, or both, Sperry plate filter presses are your guarantee of top efficiency per dollar invested in equipment and labor. Call on Sperry today!

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purchasing agent in the form of reports from a market analyst who may work directly as a full time member of the purchasing department or who who may be assigned to it from the market research department. This individual not only investigates the market conditions surrounding the materials used in the company's operation but those that might be used in the future.

Many companies in the chemical process industries have adopted the practice of sending their purchasing men on inspection trips of the suppliers' plants. This gives the P.A. an opportunity to get a first hand view of that part of industrial activity that affects him most—the suppliers' production facilities. These visits are also arranged to bring him into contact with the men who by a little effort—a little personal touch—make him the more efficient and reliable purchasing man. Many are the shipments that are pushed through on time in spite of many obstacles just because "not to deliver would make our old friend Joe, the P.A., look bad in his company."

One purchasing man expressed this idea as somewhat differently to the writer when he said; "The old days of the P.A. sitting behind his desk expecting the salesmen to offer up gifts are gone . . . today we have to go out and visit our suppliers and be awfully nice to them . . . you never can tell when or where a sellers' market is apt to develop."

No article about the function of purchasing would be complete without mentioning the basic economics involved in the job. This can be put simply in the form of two statements: (1) The purchasing agent spends an average of one half of the company's annual operating dollar. (2) A $5,000 saving in a purchasing operation is the equivalent of an additional $100,000 of sales for the average company. Truly a penny saved is a penny earned!

If the purchasing agent was ever an auxiliary member of the industrial team he certainly can't be regarded as one today. Few executives in a large modern process company have a greater sense of the over-all extent of the operations than he. And none has a better understanding of how the rise or fall of the enterprise depends upon its ability to integrate itself efficiently with the entire industrial economy. Since this type of savvy is also the hallmark of management timber, the modern purchasing department represents a major source of the management material of the future.

—End

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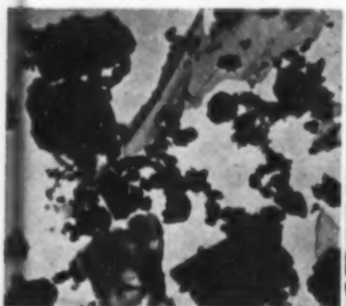
offers HIGH efficiency

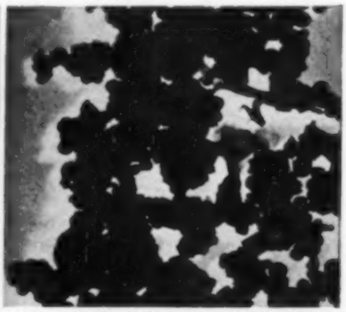
AT LOW COST

Typical efficiencies in the removal of sub-micron dusts



Activated carbon dust from rotary dryer. P-A Venturi Efficiency **98%**

Iron oxide dust from oxygen-lanced open hearth. P-A Venturi Efficiency . **99%**



Lead oxide fume from scrap lead blast furnace. P-A Venturi Efficiency . **95%**

The Electron Micrographs above show the type of dust particles the Chemico P-A Venturi Scrubber removes almost completely from industrial gases. Equally important, the price of efficient P-A Venturi performance is *low* . . . in initial cost of the equipment, in maintenance and water requirements.

For gas scrubbing, for recovery of valuable metals and chemicals or for absorption of odors, it will pay you to investigate the Chemico P-A Venturi Scrubber.

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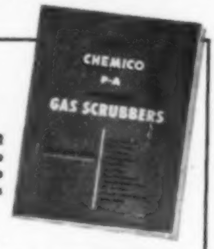

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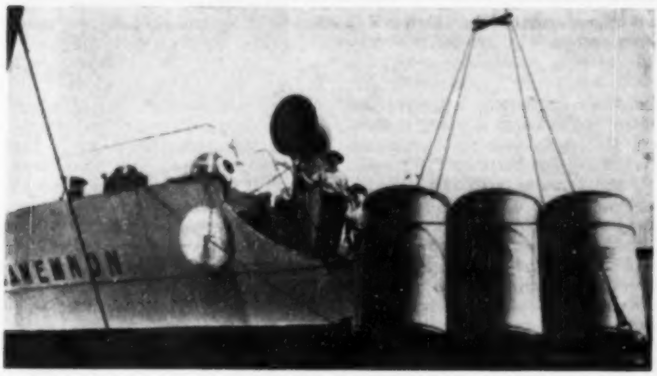
CC 806

Handling, Packaging and Shipping

R. W. LAHEY, Editorial Consultant

LIGHT AND RIGID—they fit the air-freight pattern. These drums are off to Tokyo.



DURABLE—They can take sea-trips with safety. This load is headed for Venezuela.

LONG LIFE—This drum went to Europe carrying dry milk and returned here with a Swiss product two years later.

LININGS—Polyethylene and other linings are used to keep product dry and free from impurities.

Packaging Notebook—IV

FIBER DRUMS

There have been several major changes in chemical packaging practices in the last 25 years. One of the most significant of these is the adaption of the fiber drum to meet the highly specialized packaging requirements of chemical and pharmaceutical compounds. The construction of the fiber drum lends itself admirably to the need for a "tailor-made" package as evidenced by the many special constructions devised to provide the proper protection for individual products. In addition to these special types of drums, containers of the standard or basic construction are widely used.

General acceptance of this container followed the development of machinery for convolutely winding the drum bodies and the improvement in the all kraft liner board. In addition to these two basic improvements many other changes have been brought about by the untiring efforts of the makers of these containers. The task was particularly difficult because no standard machinery or equipment was available. Improvements in container construction thus had to be followed by individual development of machinery before the improved containers could be fabricated on a production basis. The work, due to intensive efforts of the manufacturers, has been accomplished in the last two decades. The industry had just completed their development program at the outbreak of the last World War. Somehow they were able to tool up to meet the greatly increased requirements of the war economy. Their principal role during this period included many war packaging jobs such as the development and production of containers for packaging bomb clusters for the Air Force. They also were called upon to supply exceedingly large quantities of fiber containers to replace steel drums and thereby conserve steel.

Each manufacturer of these containers has developed a particular construction—the only standard being the

(Continued)

1—Wood headings, standard metal band closure.

2—Metal bottom, plywood top, Lok-Rim closure.

3—All-fiber style, headings are recessed on this type.

4—Standard metal bound, lug fasteners are used here.

5—Fiber pail, with or without bail. Note taper.

6—Metal top drum, with metal bottom. Narrow opening.

7—All-fiber style, headings are recessed in this type.

8—Metal top drum, with metal bottom. Wide opening.

convolutely wound shell. Methods of attaching the bottoms vary greatly as do the means used to secure the covers. These differences also extend to the methods used to introduce water vapor and other protective barriers and linings into the sidewalls and heads of the packages. These many variations in the construction details of fiber drums offer many possibilities for the solution of problems.

Fiber drums of the convolutely wound type entered the chemical packaging field a little more than 20 years ago. Prior to that time, they had been used for packing certain meat and other food products. One of the first chemical products to be packed in these containers was urea formaldehyde molding powders—in fact they are still the standard containers for this molding compound. They performed this difficult job so well that the use of these drums spread rapidly to many other compounds.

These drums when used for rail transportation must be fabricated to meet the specifications in Sec. 12 of Rule 41 of the Consolidated Freight Classification Committee. Some constructions have been approved by the ICC (Spec. 21A) for shipping containers for certain Class B poisons, inflammable solids, oxidizing materials and even dynamite. They are also authorized as outer shipping containers for some inflammable liquids packed in glass bottles.

Many types of water vapor barriers and linings are used in the sidewalls and heading of fiber drums. Some are buried in the sidewalls, some are used as inside linings and others are used as exterior coatings. Each manufacturer has developed a specific method of incorporating these coatings, linings and barriers into his particular construction. Exterior coatings are usually sprayed and dried by passing through heated tunnels or by infrared lamps. Some linings are sprayed directly into the containers, such as paraffin wax, silicate of soda, amorphous wax, rubber compounds, and certain synthetic resins.

In addition, linings known as free stripping compounds can be applied by spraying. These coatings prevent products which are poured as hot liquids from sticking to the container.

Barriers and linings consisting of laminations of paper board with asphalt, or of paperboard with metallic foil and resin are primarily used for water-vapor protection. Linings such as aluminum foil, glassine, cellulose acetate, pliofilm, and polyethylene, are used not only for moisture protection but also for cleanliness and chemical resistance. The films are coated on to the kraft board, or they are laminated. In some instances, the barriers are laminated between two sheets of the board. Asphalt laminated board can be used in conjunction with other vapor barriers such as polyethylene, pliofilm, etc. Laminants include asphalt, wax and synthetic resins.

Loose bag liners are also used as vapor barriers in fiber drums. At present, liners fabricated from polyethylene saran, etc. have broad application for packaging pharmaceuticals, pastes and compounds containing a substantial percentage of water.

The methods employed in attaching metal, wood and fiber headings to convolutely wound fiber cylinders are the most important feature of the construction of these containers. In fact, the ability of these containers to withstand unusual transportation abuse is dependent on the strength of this joint between the head and cylinder of the drum. Fiber heading is fabricated so that it is either slipped over or recessed inside the cylindrical bodies of the drums. The recessed type is usually fastened by metal clips or wire stitching while the telescopic or slipover type is secured to the drum by the use of gummed paper, cambric, or pressure sensitive tapes. Metal and woolen headings are held with metal locking bands or rings. Some metal headings are wire stitched

9—U-Pak is used to carry rolled materials.

11—Metal top and bottom. Note retaining clamps.

to the drum while other types are held by metal clips.

Fiber drums are fabricated in sizes from ¾ gal. to 75 gal. capacity. Diameters vary from 8 in. to 23 in. and heights from 3 in. to 42 in. For special applications, longer containers are available. These containers can be obtained in almost any size in this range. They can be used for transporting up to 400 lb. in a single drum and sometimes even greater weights may be packed of certain commodities if special authorization is procured. Each capacity of most of these containers is ordinarily fabricated in two diameters. This allows nested shipments of the empty drums which reduces transportation costs.

Having no rolling hoops or bilge, fiber drums require less storage space than most cylindrical containers. Tare weights are also favorable to fiber drums. Of the rigid containers ordinarily used for packaging dry compounds in the 41 gal. size, the fiber drum weighs about 17½ lb. the 24 gs. steel drum approximately 23 lb.

10—Stapak is equipped with metal top and metal bottom.

and the slack barrel about 25 lb.

Drums may be obtained in a choice of extenrior finishes. Clear varnish coatings provide a degree of waterproofness, dust and dirt does not settle as readily on the smooth surface and the walls can be cleaned with a wet cloth. They can be painted in a large variety of colors and can also be printed with rubber dies and by the silk screen process. Labels are an effective means of decorating, but special adhesives are required when applied on varnished or painted surfaces. It is the usual practice to stencil shipping and other information on the walls or heads of these containers. Special stencil inks are required when drums are coated with paint or varnish. If it is desired to use tags or cars instead of stencils for marking shipping data, special fittings to hold these tags can be applied to the drum heads by the manufacturers.

Proper handling of fiber drums differs somewhat from the practices customarily used in the moving of steel containers and wooden barrels. Fiber drums should not be rolled on their sides except in storage racks which are designed to support them at their chimes. Gravity or powered roller conveyors are effective methods of moving these containers. Conventional two-wheel hand trucks can be used for occasional or limited handling. Truck of special design can be used more effectively where these containers are handled in large quantities.

Fiber drums may be palletized and tiered within certain limits. The height to which these containers may be safely tiered depends on the construction of the drum. In general, loads of 1,000 lb. should not be exceeded. For authoritative information on this matter the manufacturer should be consulted.

Fiber drums should be loaded into freight cars in the nested or staggered pattern conventionally used in loading cylindrical containers. All bracing and strapping should be supported at the

(Continued)

12—Fiberpak is another all-fiber type drum.

13—Leverpak drums are recognized by the closing clamp.

PACKAGING, *cont.* . .

top and bottom chimes. Bureau of Explosives Pamphlet No. 6 and American Association of Railroads Pamphlets No. 4 and 14 give complete recommendations on proper carloading and staying methods.

In 1946, the Manufacturing Chemists Association published a manual on the handling and storage of fiber drums when filled with chemicals or allied products. Copies may be obtained from the Washington offices of the Association.

These containers have many special uses. Rolled films such as cellophane, foil, photographic and X-ray film, etc. are packed in fiber drums because the edges of the rolls are protected against damage. The drums are popular for packing fragile articles protected with inner cushioning material such as cork, sponge rubber, Kimpak, shredded paper and single face corrugated in coils. A unique application is the special construction container which is used to hold 50 lb. of dynamite. The fiber tube serves a double purpose—it is both the shell or cartridge in which the dynamite is packed and also it is the shipping container.

Industry has found that fiber drums not only have exceptionally protective features for their products but they are universally accepted by their customers. The trade appreciates the ease of emptying, complete reclamation of contents, reclosure feature, light weight, and reuse possibilities of these containers. If the accomplishments of the past are an indication of what we can expect, further major improvements in fiber drums may be looked for.

More ICC Regulation Changes For Your Files

SEC. 302(h) FOODSTUFFS are exempt from the packing requirements for COMPRESSED GASES when packed in metal cans charged with soluble non-liquefied compressed gas, provided pressure in container does not exceed 105 psi. absolute at 70 percent F. or 140 lb. psi absolute at 130 deg. F. The metal container must

(Continued)

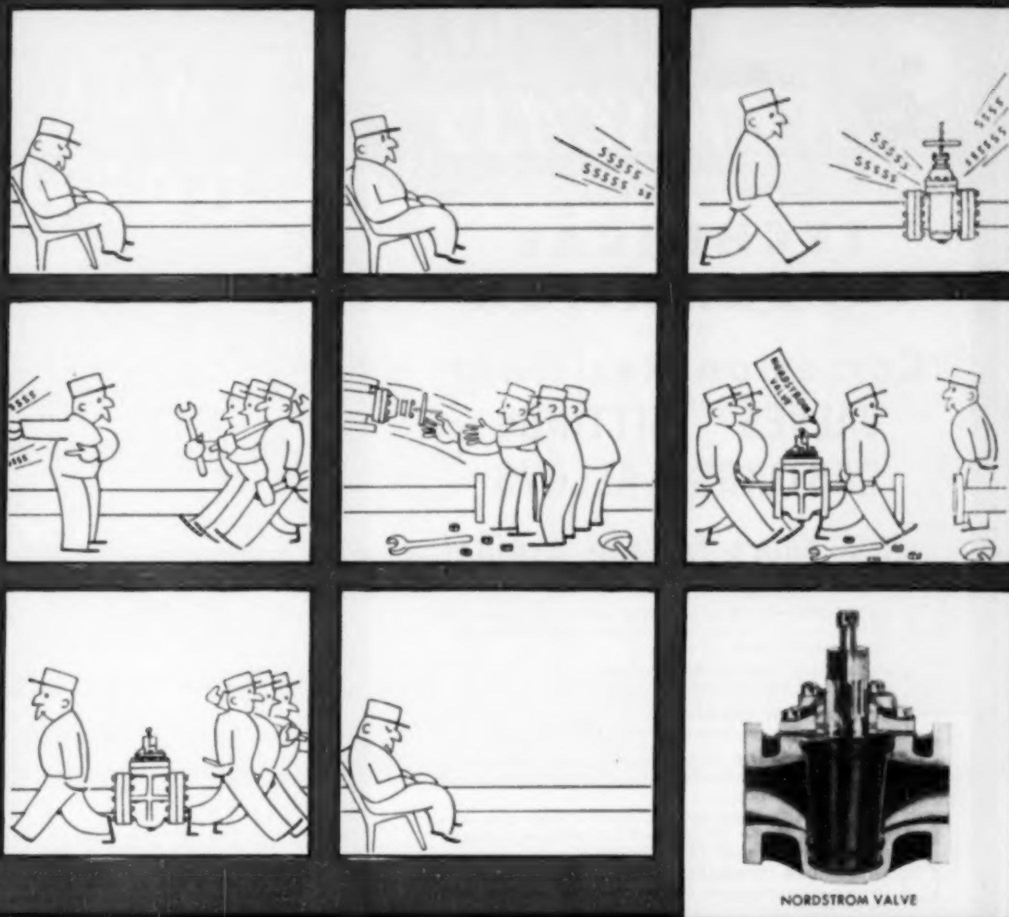
Specifications for Fiber Drums Carrying Solid Materials

Maximum Contents (Lb.)	Maximum Capacity (Gal.)	Side-Wall Test per Psi.*	Tops and Bottoms (each): Fiberboard outer ply Waterproofed Thickness (In.)		Test (Lb.)*	Steel U.S. Ga.)	Woof Thickness Solid (In.)	Woof Thickness Plywood (In.)
20	15	250	0.080 0.060	or	200 400	30	3/8	1/4
60	30	350	0.120 0.090	or	300 600	30	1/2	3/11
125	45	500	0.160 0.120	or	400 800	28	1/2	3/10
150	55	600	0.160 0.120	or	400 800	28	1/2	3/8
200	65	700	0.180 0.120	or	500 1,000	26	1/2	3/8
300	75	800	0.200 0.160	or	550 1,100	26	25/32	7/16
400	75	900	0.240 0.200	or	600 1,200	24	25/32	7/16

*When more than single ply, test may be determined by multiplying test of single sheet or ply by the number of laminations or plys.

Sidewalls may be constructed of fibreboard of single ply with outer face waterproofed and the ends of the fibreboard forming joint or overlap must extend at least 2 in. beyond beginning of the overlap and must be firmly glued together throughout entire area of overlap and such overlap must be reinforced by metal rivets, staples or stitches not more than 6 in. apart or must be fastened by a double row of metal rivets, staples or stitches not more than 2 in. apart in each row, or secured by a barbed steel strip not less than 22 ga. and not less than 1 in. wide extending entire length of joint with barbs pressed through fiberboard and clinched on inside.

Sidewall may be constructed of more than one ply not spirally wound, no single ply to be less than 0.012 in. in thickness with outer ply waterproofed and all plys firmly glued together.



SSSSS
SSSSS
NORDSTROM VALVE
NORDSTROM VALVE

be capable of standing without bursting two times pressure of contents at 70 deg. F. or 1½ times the pressure of the contents at 130 deg. F. whichever is greater.

SEC. 303K and (q)(1) METHYL MERCAPTAN is a compressed gas and may be packed to a maximum filling density of 80 percent in Spec. 3A240, 3B240, 4B240, and 4BA240 cylinders. Spec 106A-500 tank cars are also approved when filled to a maximum filling density, of 80 percent.

SEC. 303(1) ACETYLENE GAS. Changes have been made in the solid rubber or other suitable material when approved as to type and construction by the Bureau of Explosives.

SPEC. 5P. LAGGED STEEL DRUMS are designed for transporting ethylene oxide. This container is constructed of an inner straight sided steel drum lagged with suitable fire resistant material having insulating properties. This insulation is covered with a metal shell so constructed that moisture cannot come in contact with the lagging. Maximum size is set at 61 gal. capacity and the container must be equipped with safety devices to prevent bursting when drum is placed in a fire.

SPEC. 8. STEEL CYLINDERS FOR ACETYLENE. Changes have been made in the specifications for the porous material with which these cylinders are filled. The maximum amount of acetone solvent permitted has also been slightly increased. Additional types of steel for fabricating these cylinders have been added to the approved list. Welding of attachments to tops or bottoms of neckrings, footrings, handles, bosses, pads, and valve protecting rings is authorized when certain types of steels are used.

SPEC. 23F. SOLID FIBERBOARD BOXES. When used for packing ELECTRIC BLASTING caps not exceeding 35 lb. gross weight, lining tubes are not required.

SPEC. 50. UNLAGGED PORTABLE TANKS. This specification has been cancelled.

SPEC. 51. PORTABLE TANKS. Certain details of the construct-amount of solvent required in cylinders holding this gas.

MIXTURES OF COMPRESSED GASES INCLUDING NON POISONOUS AND NONINFLAMMABLE INSECTICIDES must be shipped in Spec. 3, 3A, 3B, 3E, 4, 4A, 4B, 4BA, 25, 26, 38, 9, and 40 Cylinders and in Spec. 2P inside metal containers packed in strong wooden or fiber boxes with valves protected against damage. Pressure in containers must not exceed 75 psia. at 75 deg. F. Each filled metal container must be heated until contents reach a minimum temperature of 130 deg. F. There should be no evidence of leaking, distortion or other defects.

SEC. 303(r) COMPRESSED GASES SHIPPED IN CARGO AND PORTABLE TANKS. This section of the regulations has been enlarged to include detailed instructions covering permitted weights, tank specifications for various types of gases, maximum filling densities, gaging devices, safety valves, etc.

SEC. 340(c) ARSENIC ACID. Spec. 1D carboys have been added to the list of approved containers.

SEC. 341(c) CARBOLIC ACID (PHENOL) LIQUID. Spec. 1D carboys have been added to the approved containers.

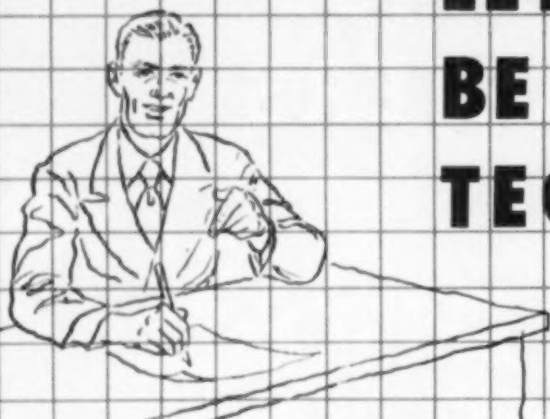
SPEC. 2P METAL CONTAINERS. This new single trip container provides for a maximum capacity of 20 cu. in. (16.6 fluid oz.) with a maximum inside diameter of 3 in. It must be seamless or have joints welded, brazed, or soldered. They must stand a minimum pressure of 180 psi without bulging. They are double seamed or swedged, single containers which must be shipped in outer shipping containers.

SPEC. 5A, SPEC. 5, SPEC. 5B, SPEC. 5C, SPEC. 5G, SPEC. 5M. RETURNABLE STEEL DRUMS may be equipped with rolling hoops of pliable ion of these tanks have been altered.

SEC. 401(a)(1) MARKING OF PORTABLE TANKS. It is required that portable tanks be conspicuously and legibly marked on a background of contrasting colors when used for transporting dangerous articles. Complete details of lettering are included.

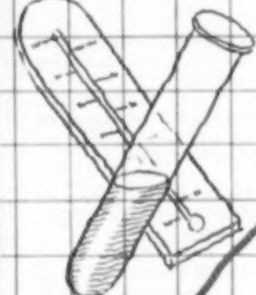
—End

LET'S BE TECHNICAL



Trained technical people are always at your command to consult on any development problem you may have. Constant research is going on all the time in order to be as helpful as we can and have ready for you the answers to any questions you may ask us.

ALLOYS
ADMIRALTY
MUNTZ METAL
COPPER
ARSENICAL COPPER
RED BRASS
ALUMINUM BRONZE
ALUMINUM BRASS
NICKEL ALUMINUM BRASS
CUPRO-NICKEL "30%"
CUPRO-NICKEL "20%"
CUPRO-NICKEL "10%"



There is a proper alloy for each purpose. The choice depends upon the nature of the fluids or gases to be encountered. Our engineers can help you immeasurably in specifying the exact alloy you should employ under any given conditions.

We can help you with the diagnosis of your heat transfer problems—discuss with you such factors as temperatures, kinds of liquids and gases and their rates of flow, as they affect efficiencies in your operations.

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DEPARTMENT OF THE MONTH

News From Abroad

(*Continued from page 123*)

the terms of a barter-type trade agreement recently negotiated for the exchange of $16 millions in goods.

Allies Spike Rumors of New German Oil-From-Coal Work

Frankfurt—The once vast German Fischer Tropsch synthetic petroleum industry is, in the words of a leading official of the American High Commission's fuel and power branch, "as dead as a duck and will remain so as long as we can see to it."

The official was commenting on rumors that German Fischer-Tropsch plants in the Ruhr were still producing petroleum out of coal in spite of a firm Allied ban. He said the last two plants working on the Fischer-Tropsch method closed down on Dec. 31, 1949, when a temporary Allied production permit for a monthly output of 5,000 tons of primary products expired. This permit had been given in June 1947.

German industrialists, however, are still hoping for an eventual withdrawal of the ban on synthetic petroleum production under the low-pressure (Fischer-Tropsch) method. Notably members of the coal processing industry have been encouraged in this hope by the fact that the six West German Fischer-Tropsch plants in the Ruhr, together with four hydrogenation plants, were exempted last December by the German-Allied Petersberg agreement from further dismantling.

Though petroleum production by the low-pressure, Fischer-Tropsch method is prohibited, two German works, the Gelsenberg Benzin AG at Gelsenkirchen and the Union Rheinische Braunkohlen-Kraftstoff at Wesseling are making petroleum from crude oil by the high-pressure Bergius hydrogenation method. These two plants are refining German and imported crude oil.

The Wesseling plant, working at about half its original capacity, operates o na contract with the Shell Oil Co. The Gelsenberg plant, working at about one-third of its original capacity, is under contract with the New Jersey Vacuum Oil Co. The two plants have been free from Allied restrictions since last autumn. Though the Allies originally decided to revive them only on a limited scale, part of the Gelsenberg plant was dismantled and shipped abroad as reparations.

The two plants are expected to process 1 million tons of crude oil this year, and Allied experts expect them to reach 2 million tons by 1952. This estimate is mainly based on rising German crude oil output.

New drilling equipment has been brought in, drilling methods improved and brought up to modern American standards, new wells have been opened, and existing holes sunk deeper. In particular new fields in the Emsland, near the Dutch border, are being exploited with American-manufactured portable drilling rigs, bought by the Germans with $1 million of ECA funds. This equipment, which is transportable on trucks, has proved far superior to the old German drilling equipment.

German crude oil production from fields in the Emsland, around Hanover, near Hamburg, and poor fields south of Stuttgart, which in 1936 amounted to 445,000 metric tons, rose by 1948 to 635,700 tons, and in 1949 to 845,500 tons, according to British Control Commission reports. German crude oil, especially the very heavy Emsland oil, is of low grade, only about 90 percent of it being fit for processing.

Egypt Plans to Expand Phosphate Operations

Cairo—Direct or indirect government aid to companies engaged in the extraction of phosphate in Egypt is urged in a report drafted by the Egyptian Ministry of Commerce and Industry. The report points out that large quantities of phosphates of lime are being exported every year, mainly to Australia, New Zealand, Italy and Spain. (Acording to official figures, exports of phosphate of lime in 1949 amounted to 145,622,636 kilograms.)

There are two local firms at present engaged in the exploitation of phosphate mines in Egypt; the Societe Egyptienne pour L'Extraction et le Commerce du Phosphate, which employs some 1,650 workers; and the Societe Egyptienne du Phosphate, which employs some 580 workers.

Swedish Chemical Output Still Growing

Stockholm—Sweden's chemical industries will increase their production volume by just over ten percent compared with 1949, according to a forecast by the Swedish Board of Trade. Sweden's total exports of chemicals, matches, explosives and concrete last year were valued at approximately $28,950,000 corresponding to 3.5 percent of Sweden's total exports.

Celanese Expands Mexican Rayon Output

Mexico City—Celanese Corporation of America's two Mexican affiliates are expected to increase their output by nearly 75 percent this year. Celanese Mexicana, at Ocatlan, which is turning out 12 million pounds of acetate filament annually, is scheduled to step up production to 14 million pounds of filament yarn plus six million pounds of staple; the other affiliate, Viscosa Mexicana, at Zacapu, is expected to be producing six million pounds of staple by the end of this year in addition to the present seven million pounds of filament. Plans for 1951 envisage a production at the Ocatlan plant of 20,000 pounds of acetate filament and eight million pounds of staple fiber and at the Zacapu facilities an output of 12 million pounds of filament and 12 million of staple fiber.

Belgium Refinery—Antwerp—Construction is now under way of a complete 30,000 bbl. per day refinery for the Societe Industrielle Belge des Petroles at Antwerp. The refinery is on a site adjacent to the Scheldt River. Completion is scheduled for mid-1951.

Achema IX—Frankfurt—This month (July 9-16)—after a lapse of 13 years—the 30-year tradition of the Achema was renewed. This year the exhibition and convention occupies eight large halls at the municipal fair grounds in the city of Frankfurt.

French Chemical Exports—Paris—The French chemical industry is in the midst of 'an investment program sponsored by the Monnet Plan which aims to double exports of chemicals by 1952.

(*Continued*)

Canadian Alcohol—Ottawa—Commercial Alcohol Co.'s plant at Gatineau, Que., is currently running just about at 2,000,000 gal. annually. A year ago it was running only approximately 50 percent.

More Power at Trail—Ottawa—At a cost exceeding $300,000 Consolidated Mining and Smelting Co. plans to increase the electrical facilities of its chemical and fertilizer plants at Trail, British Columbia. This major revision has become necessary through the gradual expansion of the plant during the past few years.

Canadian Gas—Ottawa—Imperial Oil Co.'s $4 million natural gas processing plant at Devon in the heart of the Leduc oilfield in Alberta has been opened. About 90 percent of the plant's production will be "dry" gas which can be used for domestic or commercial demand. When in full operation the unit will also produce several hundred barrels per day of "natural" gasoline suitable for blending with refinery stocks into motor gasolines.

Durban Refinery — Johannesburg — An oil refinery, which will cost between £5,000,000 and £6,000,000, may be built in Durban. Negotiations are being conducted by Harold Moore, managing director of a Durban registered company (the Union Petroleum Refinery (Pty.), Ltd.,) and the Government. The proposed refinery, which will take two years to build, will handle more than 500,000 tons of crude oil a year. Its main products will be gasoline, lubricating oils and fuel oils.

Atomic Sieve — London — An electromagnetic isotope separation plant has just been completed at the Ministry of Supply Atomic Energy Research Establishment at Harwell, Berkshire. It can "sieve" the atoms of heavy elements such as uranium, dividing them according to slight variations in weight.

German Potash — Frankfurt — West German exports of raw natural potassic salt, potassium chloride, potash sulphate, and potash-magnesia sulphate—which were initiated in July 1949—reached a total of 75,221 metric tons K_2O in the first quarter of this year according to the Bizonal Potash Sales Co.

—End

The Corrosion Forum

EDMOND C. FETTER, *Managing Editor*

How to Be Happy With Teflon Packing

Teflon can give long trouble-free service, but there are three main things that have to be right. Your packing must be properly compounded, precision fit, carefully run in.

POWER PRODUCTS CO., *a prominent producer of Teflon packing, has prepared this article at our request to help you get the exceptional service you expect of an exceptional material.* —EDITOR

As a packing material for chemical pumps, the inert qualities of Teflon leave nothing to be desired. Physically, however, while its appearance is that of a low friction material, it has proved to be totally unsatisfactory on rotating shafts. In most cases, in its pure state, it will adhere to the shaft and rotate with it, causing extreme overheating and eventual failure. In other cases, it will soften at the point of contact with the shaft due to excessive frictional heat and gradually wear away leaving an annular space along the shaft permitting excessive leakage.

COMPOUNDED, NOT PURE, FOR ROTATING SHAFTS

After a great deal of experimentation, satisfactory chemical packings for rotating shafts have been developed. For instance, as produced by Power Products Co., this packing is composed of very thin shreds of oriented Teflon fibers; orientation provides a material having molecular alignment and, consequently, low frictional qualities. These fibers are compounded with chemically resistant friction reducers, usually graphite, and molded into packing rings under extremely high pressure. This "compounded Teflon" packing material has a very low coefficient of friction and retains the corrosion resistance of pure Teflon.

Compounded Teflon packing is not adversely affected by high peripheral shaft speeds and will seal a stuffing box efficiently with very slight gland pressure, thus assuring its user of a minimum of shaft wear or overheating.

Nearly all conventional chemical or solvent packings fail eventually because corrosive or solvent action of the product being handled removes the lubrication in the packing. This generally results in costly leakage and, in most cases, more costly wear to the shaft or sleeve. Compounded Teflon packing contains no lubrication and, unlike asbestos packings, does not rely upon the retention of its lubrication for continued functioning. The component parts of these Teflon packings are chemically inert and for this reason do not require a chemical or solvent resisting lubricant to operate efficiently.

The method of installing Teflon packing is most important. The set of packing should include $\frac{1}{16}$ in. thick spacer rings between the packing rings and at the top and bottom of the stuffing box. This practice has been found most successful. The spacer rings are made of pre-shrunken pure Teflon. Their function is to keep the packing rings from molding into a solid bushing under gland pressure, and also to seal off any extreme clearance between the shaft and the bottom of the box and lantern ring. If the shaft has excessive run-out, the spacer rings will permit the packing rings to move laterally and seal effectively. It is advisable, however, to refrain from using Teflon packing on any pump having run-out in excess of 0.002 in. This condition should be corrected before installing the packing.

Pure Teflon will work successfully in valves or other locations which require a static or semi-static seal. However, in oil refineries and some processing plants there are many applications where fire is a constant menace. The compounded Teflon packing can be used safely on such applications by filling the valve or pump three quarters full of packing rings and the remainder of the stuffing box with an asbestos packing which would insulate and protect the Teflon in the event of fire. The compounded packing is resilient enough to absorb gland pressure through the asbestos rings, whereas pure Teflon would not.

For many years there has been a feeling against the use of graphite in the presence of stainless steel because of the possibility of electrolytic action and pitting of the shaft. Therefore, Teflon packing is being compounded in which the graphite is replaced with a friction reducer which will not cause electrolytic action or pitting.

PROPORTIONING PUMPS REGULATOR VALVES

Compounded Teflon packing is most serviceable in proportioning pumps because of its structure. It does not grip the rod and cause a heavy friction load which is common with most conventional type packings. This feature is advantageous because it precludes the possibility of packing drag affecting the function of the pump itself. Most conventional type packings eventually become hardened or badly worn due to the corrosive action of the product being handled and the excessive tightening required to effect a seal. This is also detrimental to the pumps' operation. One of the foremost manufacturers of proportion-pumps has standardized on compounded Teflon packing after extensive tests in their plant and in the field.

The compounded packing is also widely used and well adapted to applications in regulator valves. A perfect packing performance on a regulator valve demands that a packing operate successfully with a minimum friction load; excessive packing drag will not permit the valve to function properly. With compounded Teflon packing the gland can be tightened only finger tight and the packing will still prevent leakage.

CENTRIFUGAL PUMPS: WATCH FIT AND RUN-IN

To pack a centrifugal chemical pump successfuly with conventional packing, it has always been necessary to give the utmost consideration to shaft alignment, and the shaft itself

(Continued)

should be in good condition. Where possible, it should be hardened, ground and polished. This is particularly true when Teflon packing is being used. The user should remember that he is attempting to obtain a packing life many times greater than the life of conventional packing. The saving in shutdown time, production loss, shaft wear and general maintenance costs will more than compensate him for the trouble necessary to check the pump for alignment, and, if necessary, to equip it with a shaft in perfect condition. The eccentric or lateral motion should not exceed 0.001 in. for best results.

Nearly all chemical pumps come equipped with a lantern or seal cage. Where possible, a sealing fluid should be used. Under conditions which permit, the sealing fluid can be cold, clear water, which is preferable due to the low cost of operation and its desirability when used in conjunction with Teflon packing. When, due to the nature of the reaction, the use of water is not advisable, a suitable oil may be used in many cases.

In all centrifugal pumps it is necessary that a fluid film be present between the shaft and the packing. This film in some cases must be the product handled. However, in other cases it can be water or some other sealing fluid. In other words, in stuffing boxes on chemical pumps where chemical leakage is objectionable, the box should be set up with a fluid to provide the essential liquid mentioned above. This fluid must be introduced into the stuffing box in such a manner that it will surround the shaft and the packing.

In some cases neither water nor any other form of sealing fluid can be used. In this case it would be necessary to cool the stuffing box externally during the run-in period. This can be accomplished by running a stream of cold water on the stuffing box and gland.

Regardless of whether or not the stuffing box is equipped with a seal cage or lantern, it is necessary during the first half hour of operation to cool the gland and stuffing box externally. Teflon appears to have an exceptionally low coefficient of friction. At the same time, its low thermal conductivity retards the dispersion of frictional heat and its high coefficient of thermal expansion has the undesirable effect of reducing clearances as the temperature rises. Initial friction is always present when new packing is being run in. Many packings are caused to fail during the first half hour of operation because the pack-

(Continued)

ings were not allowed to run-in gradually.

Teflon packing will handle any corrosive product if the user will take the time and precaution to install it properly and break it in gradually, taking care to keep the stuffing box cool. If the packing appears to run warm, it would be well to stop the pump and permit it to cool down before starting up again. The packing will then take a permanent set providing an anular space around the shaft. After this point has been reached, external cooling will not be necessary.

In pump applications where the peripheral speed is low, such as on reciprocating pumps, the need for cooling during the run-in period is not as great. It should be watched, however, and if any undue temperatures rise occurs, the unit should be stopped and allowed to cool. Generally speaking, however, there need be no cause for concern in this type of application.

AGITATORS, REACTORS, AND AUTOCLAVES

Here it is recommended that pure Teflon spacer rings $\frac{1}{16}$ in. thick be used between compounded Teflon packing rings in identically the same manner as the installation recommended for centrifugal pumps.

The application on reactors is not usually difficult because the stuffing box is at the top of the unit. It is always well, however, to furnish the packing manufacturer with complete stuffing box dimensions because on some reactors the bottom of the stuffing box will require a slightly tapered ring to assure a perfect seal. These units should also be run in gradually so as to give the packing time to set properly.

Most autoclave applications include the use of a lantern or seal cage. In many cases, the lantern is sealed with a fluid at a pressure slightly in excess of the pressure in the vessel. Under these conditions, it is important that the set of packing be installed with spacers on each side of the lantern.

If a vessel is operated under a high vacuum, it is important that very accurate shaft and box dimensions be furnished the packing manufacturer so the packing rings and spacers can be molded to the exact dimensions.

Many users of chemical equipment have had some good results with chemical seals. When installing a seal, a great deal of care must be used, and, in some cases, actual alteration of the stuffing box and bearing frames must be made. If the users of Teflon

(Continued)

packing would devote the same amount of time and care to the installation of packing, the results would be quite comparable to those of a successful seal. Teflon packing does require slightly more care in the installation and during the initial run-in than conventional packing, but it has been proved to the satisfaction of many users that the extra precaution more than pays for itself in the first few months of operation.

SOLID TEFLON GASKETS

Solid gaskets of Teflon were the first type to be used and are still the most important type. They are fabricated by die-cutting from Teflon sheet, by slicing from the end of a molded cylinder or by molding directly from powder.

They may be installed in flanges of standard design; raised face flanges are normally used for low pressures, 150 to 300 psi.; some confining arrangement such as tongue-and-groove or male-and-female is used for higher pressures. For example, solid gaskets of Teflon have been satisfactory in tongue-and-groove flanges at pressures as high as 30,000 psi.

In most physical properties, solid Teflon is equivalent to rubber-bonded compressed asbestos. Therefore, gaskets designed for the two materials are similar. The only important difference is that when a compression force is applied, the deformation of Teflon is greater. After compression is released the two materials recover at practically the same rate. Both materials show a lack of resiliency. This sometimes presents a serious problem in applications where variations in temperature change the pressure on the gasket through expansion and contraction of the flanges and bolts. Spring loaded bolts are sometimes the best solution in such cases.

Orientation of Teflon exists only in sheet stock which, in the course of manufacture, is rolled and stretched. It has been found that orientation reduces the rate of deformation, but the rate soon becomes the same as in unoriented material. The only other deformation observed in gaskets cut from sheet stock is that it will shrink laterally when heated. However, this is not normally a factor in gasket use because the gasket is generally retained between flanges.

While Teflon is the answer to a great many packing problems, it is not expected that it will replace conventional type packings except where difficulties arise, mainly from corrosion. Its corrosion and heat resisting qualities make it ideal where conventional packings are short lived.—*End*

LIGHT WEIGHT

...a useful and cost-saving property of

DICALITE

MINERAL FILLERS

DICALITE MINERAL FILLERS are produced from diatomaceous silica. They are amorphous in character (not crystalline), comparatively soft and friable, and free from gritty matter. Following data give the range of properties of the many grades of Dicalite available for filler use.

Colors	gray white, buff, white
Refractive Index	1.40 to 1.48
Particle Size	from 10% retained on 150 to trace on 325 mesh screen
Weight (loose)	8 to 13 lbs. cu. ft.
Surface Area	20,000 to 100,000 sq. ft. per lb.
Porosity	approximately 90%
Melting Point	approximately 2900° Fahr.

STRUCTURE—Diatom structure of the individual particles is responsible for many of the desirable filler properties of Dicalite. Instead of being approximately spherical, each particle is irregular with a predominance of acicular and elongated shapes. Such particles form an interlacing "strawpile" pattern that reinforces and strengthens—an effect particularly noticeable in paint films, asphalt mixes, molded goods, etc.

LIGHT WEIGHT—This factor is often utilized to reduce shipping costs and for general bulking. The loose weight of Dicalite filler materials varies from 7 to 13 pounds per cubic foot according to grade. The apparent specific gravity is 0.112 to 0.21; actual specific gravity is 2.00 to 2.35.

VAST SURFACE AREA—Because of the diatom structure mentioned above, Dicalite fillers have a tremendous surface area per unit of weight. Each particle is irregular in shape and porous as well. This property is of decided benefit when the material is used as a source of silica, as a diluent for insecticides, as a carrier for catalysts, etc.

HEAT RESISTANCE—Dicalite materials have a melting point of approximately 2900° F. In addition, their high porosity makes them very poor conductors of heat. Thus, Dicalite not only improves heat resistance but reduces the heat conductivity of a material or product of which it is a part.

CHEMICAL INERTNESS—Composed of silicon dioxide (SiO_2), Dicalite filler materials are chemically inert, and can be used in compounding without special formulation in regard to reactions.

POROSITY AND ABSORPTIVENESS—Porosity or voids of Dicalite fillers will average 90%. Depending on the liquid and grade of material, absorptiveness will vary from 120% to 300% of the weight of the Dicalite. Wetability of all materials is excellent.

PARTICLE SIZE—Materials may be supplied for special purposes with virtually any particle size. The filler grades regularly supplied range as shown at the left. Predominating particle size of most grades is between 2 and 6 microns.

A Dicalite Engineer will be glad to discuss your specific application. Call or write any Dicalite office.

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION

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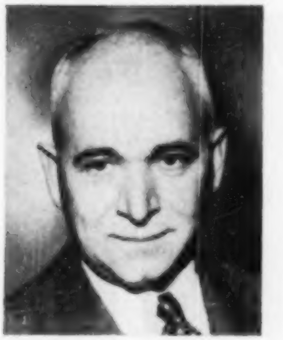
DICALITE MINERAL FILLERS

Names in the News



MAN OF THE MONTH

Lawrence H. Flett

"To the most routine and simple jobs, he always brought a fresh point of view, a speculation as to whether there might not be a new and better way of doing the old, old jobs and an enthusiastic program of investigation of what to most of us would seem merely old and dull stuff." So said a long-time associate of Lawrence H. Flett, recently re-elected president of the American Institute of Chemists. To illustrate, the speaker compared him to the little girl who, when asked what they were doing in her cooking class, replied that right now they were "reviewing toast." To this spirit Mike Flett owes his large role in the development of the chemical engineering profession and the American dyestuffs industry.

The director of National Aniline's new products division, Allied Chemical & Dye Corp., began life March 26, 1896 in Melrose, Mass., where he received his early schooling. At M.I.T. he studied organic chemistry and chemical engineering. He went to work in 1918 for the Marcus Hook, Pa., plant of National Aniline and Chemical Co., dyestuff manufacturers. With the return of German competition at that time, the American dyestuffs industry had to develop efficient commercial processes and useful organic chemicals. Mr. Flett started out to put the azo dyes on a sound basis. Revolutionary operating techniques introduced by him in those early years are still commercially practiced.

When the 1929 depression came there was available a line of products of better quality than had previously been imported. The company felt it was time to organize a group to expand the development of new products. Mr. Flett was put in charge. To their credit must go many dyestuffs, intermediates, and even an entirely new class of dyestuffs. One of Mr. Flett's greatest achievements was the development of the first commercial synthetic detergents prepared from petroleum. His product had a powerful washing action, was stable in hard water and in neutral or acid solutions and was a very efficient dispersing agent under all conditions of service. Some of the patents he holds in Canada, Germany, France, Switzerland, Argentina and the United States cover detergents of the higher alkylarylsulphonate type, applications of these detergents, dyestuffs and intermediates.

In recognition of his ability in industrial research and of his encouragement to the spirit of research in industry, the western New York section of the American Chemical Society awarded to him the Jacob F. Schoellkopf Medal in 1942.

Mr. Flett was assigned to his present post in New York in 1944. He and Mrs. Flett live in Scarsdale. He likes gardening and skiing; has the kind of sense of humor that makes him a first rate storyteller.

Carl S. Miner, director of Miner Laboratories, Chicago, has been selected to receive the 1950 Honor Scroll Award of the American Institute of Chemists, Chicago chapter. He is particularly known for his contributions to the manufacture of furfural, now used as a basic material for nylon. In 1949 he received the Perkin Medal of the Society of the Chemical Industry.

Robert C. Medl has joined the staff of the Quaker Chemical Products Corp., Conshohocken, Pa., as technical director. Previously, he was vice president and technical director of the McCormack-Medl Corp., Camden, N. J., manufacturers of surface coatings.

Ralph F. Hoeckelman of Battelle Memorial Institute has been awarded the Turner Book Prize for 1950 by the Electrochemical Society. The award is made each year for the best paper submitted by a young electrochemist.

Harvey N. Davis has retired as president of Stevens Institute of Technology, Hoboken, N. J.

Barry Moyerman has been appointed district sales engineer in the Philadelphia-Baltimore area for the Industrial Filter & Pump Mfg. Co. He was formerly a chemical project engineer with Publicker Industries, Inc.

John P. Remensnyder, president of Heyden Chemical Corp., New York, and **Ralph N. Lulek** and **Simon Askin**, both vice presidents and directors of that corporation, have joined the board of directors of American Potash & Chemical Corp.

J. J. Kerrigan

H. W. Johnstone

James J. Kerrigan has been elected president of Merck & Co., Rahway, N. J. He succeeds **George W. Merck**, who continues as chairman of the board. **Henry W. Johnstone** has been elected senior vice president.

William Kirk has retired from his post as assistant general manager of the organic chemicals department of E. I. du Pont de Nemours and Co., Wilmington. He has been succeeded by **Samuel Lenher**, formerly the department's director of manufacture.

Joseph J. Burbage, assistant laboratory director of Monsanto Chemical Co.'s Mound Laboratory at Miamisburg, Ohio, has been appointed executive director of atomic energy projects and assistant director in charge of administration at Monsanto's central research department in Dayton.

Walter Celmer and **Philip N. Gordon** have joined the research staff of Chas. Pfizer and Co., Brooklyn, N. Y.

Ambrose W. Staudt, manager of the market research section of E. I. du Pont de Nemours & Co.'s trade analysis division, has been transferred to the rayon department

(Continued)

where he will be engaged in market research studies.

John C. Cotner has been appointed president of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

Walter Coopey has retired as engineering consultant, polychemicals department, Belle Works, E. I. du Pont de Nemours & Co., Charleston, W. Va.

Kent R. Van Horn has been made associate director of research for Aluminum Co. of America, New Kensington, Pa.

L. B. Pope

E. C. Fetter

Lester B. Pope has been made managing editor of *Chemical Engineering*. He succeeds **Edmond C. Fetter** who has resigned to join the public relations department of E. I. du Pont de Nemours & Co., Wilmington.

In addition to managerial duties Mr. Fetter has been in charge of rounding up specialists for, and conducting, the "Corrosion Forum" department. He's a Lehigh graduate; was born in Hamilton, Ontario, and raised in Pennsylvania.

Les Pope has been associate editor in charge of copy. This means that it is largely through his efforts that our monthly quota of editorial wordage goes to the printer in readable form—or, at times, that it goes to the printer at all. He's also the man responsible for most of the reviews leading off our "Chemical Engineer's Bookshelf." He came to *Chemical Engineering* in 1939 via Columbia University and *Scientific American* where he was an associate editor.

Norman H. Collisson has been elected a vice president of Ecusta Paper Corp., Pisgah Forest, N. C.

Robert F. Marschner of the Standard Oil Co. (Indiana) has been elected chairman of the Chicago section of the American Chemical Society. With Standard Oil since 1934, Dr. Marschner's researches have been on the nature of hydrocarbons, catalysts in hydrocarbon conversions, mechanism of catalysis.

James I. Hoffman, chief of the surface chemistry section of the National

(*Continued*)

NAMES IN THE NEWS, *cont. . .*

Bureau of Standards, has been elected president of the Chemical Society of Washington for 1951.

Paul F. Preston has been appointed manufacturing manager of the General Electric Co.'s chemical department, Pittsfield, Mass. Prior to this, he was manufacturing and engineering manager of the department's chemical division.

Sawyer F. Sylvester has been appointed assistant to the director in the textile chemicals department of Monsanto Chemical Co.'s Merrimac Division. He has been serving as the department's sales development manager.

William M. Rand, president of the Monsanto Chemical Co., St. Louis, Mo., has been chosen to receive the Chemical Industry Medal for 1950. Mr. Rand, who is also president of the Manufacturing Chemists' Association, was elected to receive the medal by the executive committee of the American section of the Society of the Chemical Industry sitting as the committee of award.


W. M. Rand


C. L. Faust

Charles L. Faust, head of electrochemical engineering research at Battelle Institute, Columbus, Ohio, has been named president of the Electrochemical Society. Dr. Faust has been a pioneer in the development of electropolishing. **R. J. McKay**, chemical engineer for the International Nickel Co., has been elected a vice president.

Carl F. Schnuck has been appointed director of engineering for Farrel-Birmingham Co., Ansonia, Conn. **Warren C. Whittum** has been made chief engineer.

A. S. Johnson has been appointed general manager of National Carbon Division of Union Carbide and Carbon Corp., New York.

Lloyd J. Hughlett has joined the staff of Arthur D. Little, Inc., Cambridge, Mass. Formerly with

(Continued)

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PICTURES AT RANDOM FROM THE GRAVER ALBUM...

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A DIVISION OF GRAVER TANK & MFG. CO., INC. EAST CHICAGO, IND.

NAMES IN THE NEWS, cont. . .

McGraw-Hill International Corp. as editor of *Ingenieria Internacional Industria and Construccion*, Mr. Hughlett will now be primarily engaged in studies leading to programs for regional economic development.

Harold A. Knight, formerly with the Journal of Metals in New York, and **John F. Bohmfalk, Jr.**, formerly with the Office of Rubber Reserve, Washington, D. C., have been made associate editors in the New York office of *Chemical and Engineering News* and *Industrial and Engineering Chemistry*, ACS publications. **Rodney N. Hader**, formerly with Firestone Tire & Rubber Co., Pottstown, Pa., has been assigned to the society's Chicago office; **William Q. Hull**, formerly with the Houston Lighting & Power Co., has become associate editor in charge of the San Francisco regional office.

J. N. Welsh

T. H. Daugherty

John N. Welsh has been named associate director of Hall Laboratories, Pittsburgh. He will continue as director of engineering service, a post he has held since 1939. **Thomas H. Daugherty** has been named director of research for Calgon, Inc., Pittsburgh, another associated firm in the Hagan Corp. group. Formerly assistant director of research, Dr. Daugherty will supervise development work in the application of the company's sodium phosphate glass.

Sylvan B. Lee, formerly assistant director of microbiological research and development for Merck & Co., has been appointed director of microbiological research of Commercial Solvents Corp. at its laboratories in Terre Haute, Ind.

A. Dexter Hinckley, executive secretary of the Illuminating Engineering Society, has been elected president of the Columbia University Engineering School Alumni Association.

Sam Norris has been elected president

(Continued)

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Effect of Higher Temperatures on Tube Life

In general, corrosion reactions are speeded up by a rise in temperature. Tests conducted in 3% sodium chloride solutions revealed that the depth of pitting doubles for each 20° C. rise in temperature in the range of 18° to 75° C. The effect of temperature on corrosion rate is influenced by the nature of the corrosion medium—water or other liquid, or gas—and the character of the metal or alloy in contact with this medium.

Why Warm Waters Are More Corrosive

In sea water, a small rise in temperature often leads to a higher rate of corrosion, resulting primarily from greatly increased bacterial activity. With higher temperatures, organic decomposition is more active resulting in the generation of hydrogen sulphide and other odoriferous sulphur and nitrogenous compounds. The presence of even a trace of hydrogen sulphide accelerates the rate of impingement corrosion and changes the character of films of corrosion products.

Records clearly indicate that tube failures during warm seasons, in some localities, are far greater than those encountered during the winter. Condenser tubes installed during the summer often do not develop a satisfactory protective film and consequently may fail prematurely.

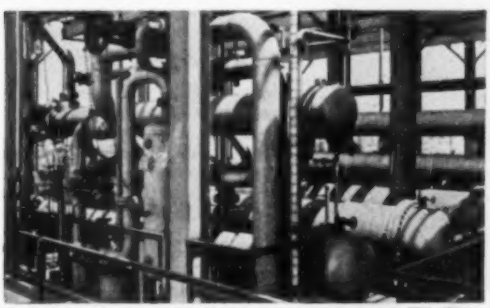
Protection By Scale Formation

In fresh waters, higher temperatures may be responsible for reducing the corrosion rate. With rise in temperature, certain waters precipitate minerals forming a brown or gray protective scale on the tube surfaces in water heaters, exchangers and evaporators. The scale, essentially of calcium carbonate or silicate, may become quite thick.

Evaporation of sea water and fresh waters may lead to concentration of mineral matter to a point where precipitation of thick mineral scales occurs which may build up at rates as high as 0.0625" per month or even higher depending upon the size of coil and amount of water being evaporated. Unfortunately, excessively thick mineral scales interfere with heat transfer properties and must be removed.

Hot Wall Effect

Sometimes severe local corrosion or pitting can rapidly perforate heat exchange tubing on the water or liquid side. Air bubbles or debris separating from the water cling to the metal surface at certain points and act as heat insulators thus allowing small areas to become hotter locally, approaching the temperature of the hot liquid or gas on the other side of the tube wall. Corrosion at these points proceeds at a rate corresponding with this higher temperature. This accelerated corrosion rate is not encountered where the tube surfaces are kept smooth and clean.



Reactivator and mixer condensers and gas intercooler, courtesy Tide Water Associated Oil Company, Bayonne, N. J.

Suggested preventive measures are:

Lower operating temperatures.

Clean tubes immediately when water carries in much debris, mud, silt, rust, etc.

Increase water velocity to help dislodge debris and bubbles of gas.

Feed Water Heaters

Because of the less corrosive nature of the water and the small amount of mineral matter, serious scale formation or deposits are not generally formed in feed water heater tubes. The chief effect of the higher temperature is to lower the physical properties of the metal and increase the creep rate. Higher pressures and temperatures can be handled by tubing with heavier wall thicknesses designed for such service. Cupro Nickel (70-30), because of its low creep rate at higher temperatures, is popular for use in feed water heaters which operate between 500°-600° F.

Performance Records Important

We find that more and more engineers in oil refineries and power plants are keeping careful records of tube life on each condenser and heat exchanger in their plants. Often special units are operated with experimental tubing and piped so that they can be by-passed in order to study the effects of corrosion.

If tubes fail prematurely then studies are immediately started to determine whether the correct alloy has been selected or whether changes in the operating procedures must be made.

Whereas the Admiralty alloy was formerly standard for practically all oil refineries, many are now using Aluminum Brass, Aluminum Bronze or Cupro Nickel, especially if the plants are located on the seaboard where corrosion is excessive.

Engineers who need help on their tube problems can call on Bridgeport's corrosion laboratory. Much information can also be found in Bridgeport's "Condenser Tube Manual" and "Duplex Tubing Technical Bulletin No. 1950", available upon request made on company stationery.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

of Amperex Electronic Corp., Brooklyn, N. Y.

Robert T. Wood has been named chief metallurgist of magnesium products for Aluminum Co. of America, Pittsburgh, Pa.

Monte C. Throdahl has been appointed research supervisor in rubber chemicals for Monsanto Chemical Co.'s rubber service department. **Paul M. Downey** and **Marion Harman** have been appointed group leaders.

George M. Powell, technical head, vinyl coatings research, Union Carbide and Carbon Corp., South Charlestown, W. Va., has been presented with the John Wesley Hyatt Award for distinguished achievement in plastics. Mr. Powell was honored for his work in planning and directing the development, formulation and application of Vinylite dispersion resins.

G. M. Powell

F. D. Rossini

Frederick D. Rossini, formerly chief of the thermochemistry and hydrocarbons section of the National Bureau of Standards, has been named to receive the Department of Commerce Exceptional Service Award for his contribution to the field of hydrocarbon research. His work has been an important factor in the development of processes for getting more gasoline from a given amount of petroleum and for producing high octane fuels. He has just been appointed head of the chemistry department of Carnegie Institute of Technology. He holds a new professorship in chemistry established through a grant by the Gulf Oil Corp.

John Ray Dunning, professor of physics scientific director of Columbia's new cyclotron at Irvington-on-Hudson, N. Y., and a pioneer in atomic research, has been appointed dean of the school of engineering at Columbia.

Merton B. Lilly has been appointed

(Continued)

head of the patent department of Wyandotte Chemical Corp., Wyandotte, Mich.

Murray Senkus has been appointed director of research and development for Nox-Rust Chemical Corp. He was formerly a group leader in the research department of Commercial Solvents Corp., Terre Haute, Ind.

E. H. Northey

J. T. Thurston

Elmore H. Northey has been made assistant to the vice president in charge of research and development of American Cyanamid Co., New York. He received his undergraduate and graduate training in organic chemistry at the University of Minnesota. He joined the Calco Chemical Division in 1932 and was assistant director of research in charge of research and development on pharmaceuticals when he was transferred to Stamford. **Jack T. Thurston** has been appointed administrative director of the Stamford Research Laboratories, Stamford, Conn. **Joseph H. Paden** has been made director of the research division of the laboratories.

M. A. Williamson, formerly a vice president of McGraw-Hill Publishing Co. and publisher of *Chemical Engineering* and *Food Industries*, has joined Van Diver & Crowe, Inc., New York advertising agency, as vice president. Mr. Williamson will be responsible for the development of new agency clients particularly among companies having both industrial and consumer problems.

E. Leon Foreman has been made research director in charge of all laboratories and new product development for Special Milk Products, Inc., Los Angeles.

E. H. Wright has been named chairman of Engineering Institute of Canada, Edmonton.

William J. Haley has been elected president of Esso Export Corp. **Harold W. Fisher** has been ap-

(*Continued*)

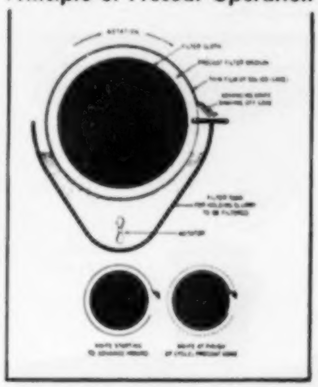
OLIVER PRECOAT FILTER

(Lead Protected)

Solves an Unusual Filtration Problem!

- **The operator is a manufacturer of automobile bumpers.**
- **The solution handled is a sulphuric acid "brightener" bath following the nickel plating operation in an automatic plating system.**
- **The problem was to remove continuously the solids formed by chemical reaction during this "brightening" operation, solids difficult to filter because they tend quickly to blind a cloth. These solids, if permitted to remain, would result in faulty finishing which in time would cause pitting and rusting.**

Principle of Precoat Operation



Here's how the Oliver Precoat Filter handles this situation: as the drum, precoated with about 2 inches of diatomaceous earth, revolves in the vat a thin film of solids is deposited on the surface. This film is carried around to the discharge point where it is shaved off by a knife edge traveling in toward the drum at a very slow rate. The cleaned surface of precoat enters the tank for further cake deposition. The key to the success of this operation is that the film is removed continuously and not allowed to build up to a point where it slows down filtration. The precoat layer lasts several days. It takes about two hours to replace the precoat.

At this plant, the Oliver Precoat Filter is keeping the solids content down to 0.062% which is well within safe limits.

Here is an excellent example of the *value* of the wide selectivity in filter types provided by the Oliver United line. There are many other types, each with its special advantage. But for this problem, the Precoat proved best.

With many filter types available plus more than forty years of filtration experience, wouldn't it be logical to bring *your* filtration problem to Oliver United?

OLIVER UNITED FILTERS INC.

New York–33 West 42nd Street
Oakland–2900 Glascock Street
Chicago–221 N. La Salle Street
San Francisco–260 Calif. St.

Factories: Hazleton, Pa. • Oakland, Calif. Cable–OLIUNIFILT Export Sales Office–New York

pointed to succeed him as coordinator of the refining operations of Standard Oil Co. (New Jersey).

John T. Byrne has been chosen as the second recipient of the $2,500 Merck Graduate Fellowship in Analytical Chemistry, administered by the American Chemical Society.

F. S. Mallette has been made assistant director of research, air and stream pollution control, for the American Steel and Wire Co.

E. H. Bohle, manager of the commercial research division of the Jefferson Chemical Co., New York, has been elected president of the Chemical Market Research Association. Other officers elected were vice president, **R. M. Prather**, Merck & Co., Rahway, N. J.; treasurer, **J. D. McPherson**, American Cyanamid; recording secretary, **Paul Weller**, Wyandotte Chemicals Corp.; corresponding secretary, **Fritz Von Bergen**, Westvaco Chemical division of Food Machinery & Chemical Corp.

E. H. Bohle

R. Calvert

Robert Calvert, chemist and patent attorney, has been elected president of the Technical Societies Council of New York, Inc. **Paul T. Onderdonk** has been elected vice president; **Richard F. Warren**, market editor of *Chemical Engineering*, has been made secretary and **T. R. Leadbeater**, treasurer.

Melvin L. Bunting has been appointed technical service engineer for Acheson Colloids Corp., Port Huron, Mich. His former position was with the production and quality control department of the U. S. Gypsum Co., Detroit.

Lawrence J. Finnan, Jr., has been appointed director of purchases for Hercules Powder Co., Wilmington, Del.

W. A. Lutsch has been made manager of branch office operations in Detroit and the state of Michigan for Dearborn Chemical Co., Chicago.

(Continued)

William Jamieson has been named vice president of industrial sales and **Lewis Blackhill** as assistant vice president of Dearborn Chemical Co. (Toronto).

Charles L. Haslup has been appointed sales manager of the R-P&C valve division of American Chain & Cable Co., with headquarters at Reading, Pa.

J. R. Keach, general manager of Quaker Rubber Corp., Philadelphia, has been elected a director and vice president of the company.

E. N. Rosenquist has been appointed assistant director of the central research department of Monsanto Chemical Co.

Arthur H. Martin has been appointed president of Chemical Developments of Canada Ltd., Ottawa. Newly appointed vice presidents are **Carey R. Wagner** and **Douglas S. Calder.**

OBITUARIES

David M. Goodrich, 74, recently retired chairman of the board of B. F. Goodrich Co., died in his home in Mt. Kisco, N. Y., May 17.

Charles S. Northen, 81, food chemist, died at Ocala, Fla., May 18.

Edward B. Heyden, 52, head of Graver Construction Co., and vice president of Garver Tank & Mfg. Co., died in his home in Cranford, N. J., April 18.

Edward F. Everett, 35, chemical engineer with Houdry Process Corp., Philadelphia, died May 24.

Willis F. Washburn, 64, who played a major role in the improvement in the manufacture of titanium pigments, died at Waterville, Maine, May 24.

Ralph Prater, 53, president of Prater Pulverizer Co., Chicago, died in Van Nuys, Calif., May 25.

A. H. Winheim, president of Planetary Chemical Co., St. Louis, Mo., died in an automobile accident June 3.

Thomas S. Hammond, 56, chairman of the board, Whiting Corp., Harvey, Ill., died in Chicago on June 15.

Quick Change

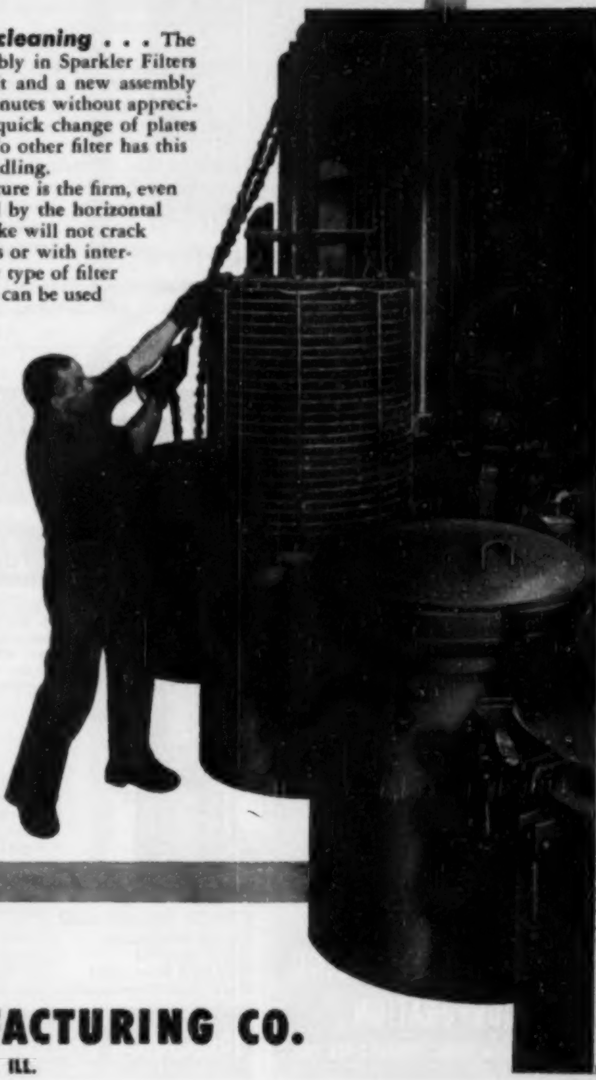
...of filter plates in SPARKLER FILTERS

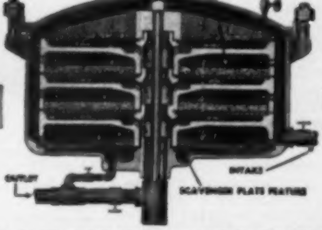
means no shut-down for cleaning . . . The entire horizontal filter plate assembly in Sparkler Filters can be removed as a complete unit and a new assembly lowered into the filter in a few minutes without appreciable interruption in service. This quick change of plates is an exclusive Sparkler feature. No other filter has this unit assembly of plates for fast handling.

Another distinctive Sparkler feature is the firm, even support of the filter cake provided by the horizontal position of the plates. The filter cake will not crack or slip under variation in pressures or with intermittent operation of the filter. Any type of filter paper, cloth, screen, or filter media can be used without danger of breaking. There is no supporting strain on these materials.

Sparkler filters take up little floor space, are completely enclosed, and are available in stainless steel, mild steel, rubber lined, steam or brine jacketed, monel, nickel, or bronze. They are capable of efficiently handling practically any kind of liquid from thin alcohols to varnishes and resins.

Sparkler service includes laboratory test runs and engineering of continuous flow filtration for production line installations. Write, giving details of your filtering problem.





SPARKLER MANUFACTURING CO.

MUNDELEIN, ILL.

NEW FACILITIES

Nicholas Engineering & Research Corp., New York—A spray dryer division to coordinate its engineering and research with those of A/S Niro Atomizer, Copenhagen, Denmark. Except for the atomizers, all parts of the dryers are manufactured in the United States.

R. S. Aries & Associates, New York—A department to handle process evaluation, economic surveys, pilot plant tests and plant design for hard and soft wallboards.

Chicago Steel Service Co., Chicago—An office and warehouse at 45th St. and Kildare Ave., Chicago, to be completed late this fall.

DeVilbiss Co., Toledo—A plant in Somerset, Pa. When completed, it will increase the company's output of air compressor outfits, spray painting equipment, atomizers.

A. O. Smith Corp., Milwaukee—Electric motor manufacturing facilities in the east through the purchase of Whirl-A-Way Motors, Inc., Tipp City, Ohio.

Abbott Laboratories, North Chicago, Ill.—A Philadelphia branch headed by Charles Moyer.

Eastman Kodak Co., Rochester, N. Y.—A wholesale branch in Dallas, Tex., to serve Texas and the Southwest.

Owens-Illinois Glass Co., Toledo—An Oklahoma City branch for its Kaylo Division. The company has also reestablished its Atlanta branch and transferred its Dallas branch to Houston.

Pennsylvania Salt Mfg. Co., Philadelphia—A district sales office in Detroit to serve Detroit and southern Michigan. Harry G. Potts, district sales manager of the heavy chemicals department, will be in charge. The company's former sales office at its Wyandotte, Mich., plant has been discontinued.

(Continued)

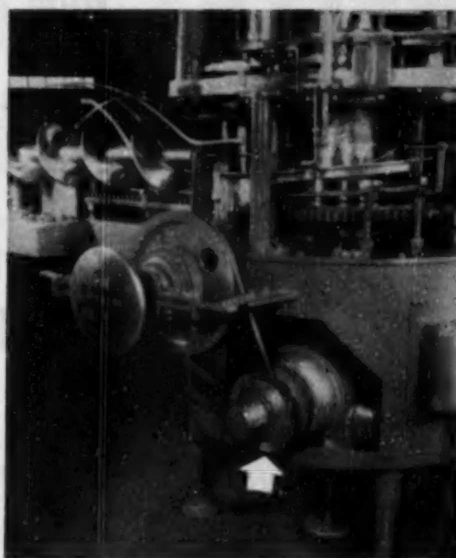
Widen the work range of your machines with REEVES Variable Speed Control

It's easy enough to get a machine, to do *one* "trick." But when that machine is called upon to handle one material, size or shape today and another tomorrow—*that's just asking too much of a one-speed machine!*

What that machine needs is REEVES Variable Speed Control—to make it more versatile, more adaptable, immediately responsive to every changing condition. Then its work range is increased, it turns out more work, more kinds of work, better work. An operator will always use the right speed because he can secure it so easily. He simply turns a handwheel or pushes a button.

If any machines in your plant are limited by fixed speeds—which require changing belts and pulleys for every change of product or process—investigate REEVES Speed Control. The cost will likely be far less than you expect; results will be immediate and continuous.

Only REEVES builds a complete line of speed control equipment—built around three basic units—to insure the correct installation for your special requirements. Write for copy of most comprehensive book on speed control ever published, Catalog CE43-3N.



Vari-Speed Jr. Permits Filler to Handle a Wide Range of Varying Product Consistencies

This Utility Filler, used in the Food and Chemical Industries, is standardly equipped with a No. 860 REEVES Vari-Speed Jr. When required by the application, a sprocket is also supplied to provide a direct drive from the closing machine used in conjunction with the Filler.

The 1½ hp motor is mounted on a special pivoting base, the position of which is controlled by a crank located beneath the motor. With REEVES on the job, capacity of the Filler can be varied from 30 to 75 containers per minute. Filler may be operated at varying speeds to compensate for changes in consistency of different products being filled.

This is but one of thousands of applications on record in which REEVES Speed Control widens the work range of machines—lowers the cost of doing business. See the listing below for other money-saving functions performed by REEVES.

REEVES PULLEY COMPANY, COLUMBUS, IND.

Recognized Leader in the Specialized Field of Speed Control Engineering

accurate · variable
REEVES *Speed Control*

Other Uses:

Handle more shapes, sizes and materials • Match skills of operators • Compensate for changes in character of product in process • Maintain uniform peripheral speeds • Maintain uniform pressure, temperature, liquid level, etc. • Regulate conveyor speeds • Synchronize parts of one machine or different machines operating in series.

Norcross Corp., Newton, Mass. – A sales and service office in Jersey City, N. J., to serve the New York territory. In charge will be George Apfel.

I-T-E Circuit Breaker Co., Philadelphia–A separate small circuit breaker division, to afford more flexible and complete service. Frederick G. Schmidt, who has been assistant to the president, has been appointed manager.

NEW LOCATIONS

United States Rubber Co., New York, has transferred its sales and technical service headquarters for vinyl resins to Naugatuck, Conn.

McDonnell & Miller, Inc. has moved its home offices into a new building at 3500 North Spaulding Ave., Chicago. The company manufactures boiler water level controls and other safety devices for steam and hot water boilers.

Chicago Bridge & Iron Co. has moved its San Francisco branch office to 200 Bush St.

R. S. Aries & Associates has moved its executive offices to 400 Madison Ave., New York. General engineering and drafting offices remain at 26 Court St., Brooklyn, N. Y.

Sylvania Electric Products Inc. has consolidated its New York offices in a new headquarters at 1740 Broadway.

Interchemical Corp. has moved its Fair Lawn headquarters to Hawthorne, N. J.

Orelite Products Corp. has moved its office, laboratory and factory to Lodi, N. J.

Filtrol Corp. has moved its new national headquarters to 727 West 7th St., Los Angeles. The company produces chemically treated materials.

NEW COMPANIES

Laclede Arch Co., Chicago, to handle industrial furnace enclosures. It is a division of Laclede-Christy Co., St. Louis. Walter W. Shipley, formerly vice president of the parent company, has been made president.

Jerguson Tress Gage & Valve Co., Ltd., London, England, to mer-

(*Continued*)

THE PUREST CAUSTICS ARE MADE IN NICKEL EQUIPMENT

Let that fact help you fight caustic corrosion in your plant!

Nickel tank and agitator used in production of magnesium hydroxide.

Flaker and breaker used to convert molten sodium hydroxide to flake caustic. All surfaces exposed to caustic are Nickel, except Ni-Resist® cooling drum.

Soap-boiling kettle, 11 feet in diameter, 21 feet deep. Fabricated from 10% Nickel-Clad Steel.

Monel® trimmed valve for handling caustics in petroleum refinery. Monel is a high Nickel alloy.

Nickel-Clad Steel tank car for transporting the iron-free liquid caustic needed by rayon, soap and film industries.

Yes, the purest caustics are *made* ... *stored* ... and *transported* in Nickel equipment.

So what better recommendation could you follow when selecting plant equipment to withstand the corrosive attack of caustic alkalies?

In Nickel you have a metal that has repeatedly proved its ability to resist corrosion and guard product purity.

Nickel offers an unusual combination of properties ... corrosion resistance, strength, high heat conductivity and ease of fabrication.

Nickel comes in all forms ... standard mill shapes, pipes, tubing, sheet, fittings, wire and woven wire cloth.

And, where you need *extra thick* sections for large pieces of equipment, you can use Lukens Nickel-Clad Steel at a saving over solid Nickel plate.

• • •

If you have any problem involving corrosion control, pass it on to Inco. We have the men and the metals to help you. Write for a Corrosion Data Work Sheet as the first step toward solving your problem.

NICKEL for purity — for economy — for safety

EMBLEM OF SERVICE — INCO — TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N.Y.

chandise and service on a world-wide basis the gages and valves of Jerguson Gage & Valve Co., Somerville, Mass.

Caldwell Chemical Co., New York, to sell and distribute industrial chemicals. A branch office has been set up in Detroit.

Industrial Nucleonics Corp., Columbus, Ohio, to manufacture and deal in instruments, gages, meters, counters, machinery and appliances used in the chemical fields.

Mathieson Hydrocarbon Chemical Corp. to produce a number of chemicals from hydrocarbons contained in the natural gas stream transported by the Tennessee Gas Transmission Co. over its pipeline network from Texas and Louisiana to the northern and eastern markets. The company has just been organized as a joint venture of Mathieson Chemical Corp. and Tennessee Gas.

Stainless Products Corp., New York, to market tanks of stainless steel and allied metals on a world-wide basis.

NEW NAMES

Vulcan Proofing Co., Brooklyn, N. Y., has changed its name to Vulcan Rubber Products, Inc.

Albert & Davidson Pipe Corp., Brooklyn, N. Y., jobbers in iron and steel pipe, valves and fittings, has changed its name to Davidson Pipe Co.

Dryomatic Corp. of America, manufacturers of dehumidifying units, has changed its name to Dryomatic Corp. Reorganized as a Virginia corporation, it has moved its plant and main offices from Baltimore, Md., to Alexandria, Va.

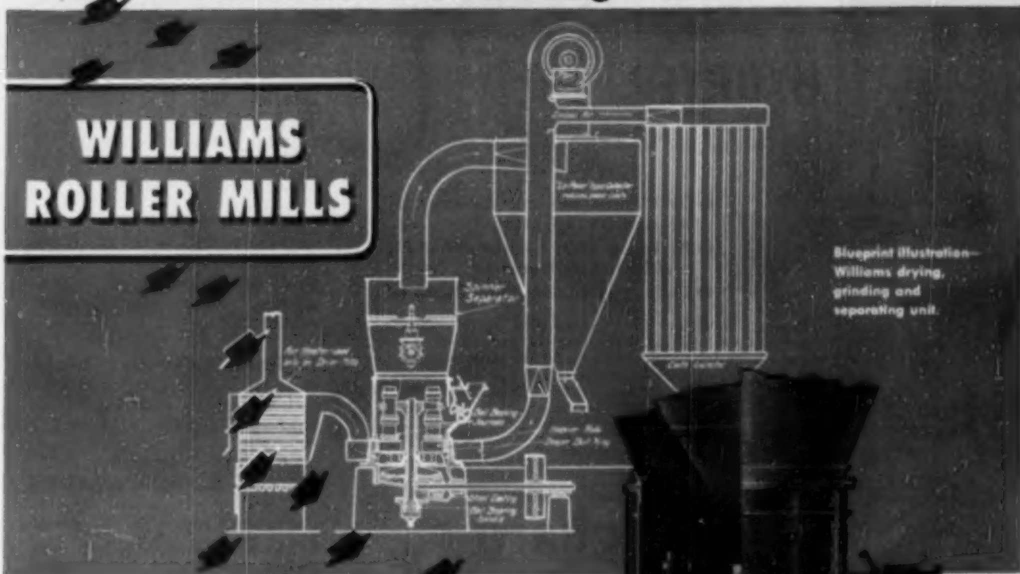
Hapman Conveyors, Inc., and **C. H. Dutton Co.** have changed their name to Hapman-Dutton Co. It will be composed of the Hapman Conveyors Division, Detroit, and Dutton Boiler Division, Kalamazoo, Mich.

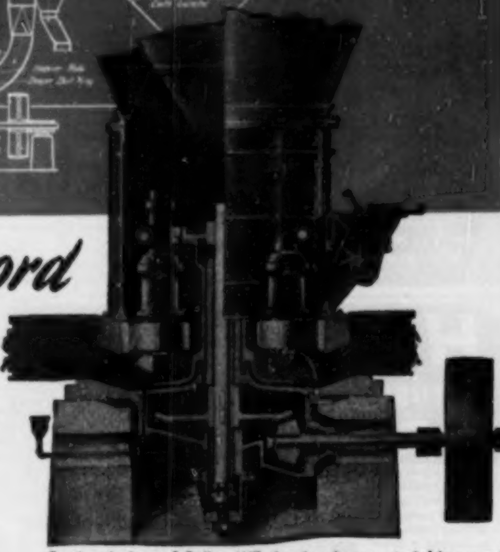
NEW LINES

Aluminum Co. of America has assumed the magnesium fabricating activities of its subsidiary, American Magnesium Corp., Cleveland, which has become inactive. Operations will continue at Cleveland.

(*Continued*)

For those Fine Grinding Jobs . . .





Sectional view of Roller Mill showing how material is ground between rolls and bull ring, then air swept to Separator which extracts fines and returns oversize for re-grinding.

let's look at the record

PYRETHRUM AND OTHER FIBROUS INSECTICIDES

The Williams Roller Mill has given excellent results in the grinding of various rotenone bearing insecticides as it pulverizes the fibres to the same uniform fineness as the rest of the plant. Pyrethrum flowers can be pulverized to 98.5% passing 200 mesh. Also grinds D.D.T., Sodium Fluoride, etc.

PAINTS, PIGMENTS, DRY COLORS

Williams Roller Mills are establishing remarkable records in the grinding of pigments and dry colors to finenesses of 99.95% 325 mesh and finer. Fineness instantly changed by varying speed of Spinner Separator Blades.

FINE GRANULATIONS

Williams has developed a special type of impact pulverizer to operate in connection with the air separator for the making of fine granulations of 30 to 80 mesh with a minimum of fines.

BARYTES, PHOSPHATE, LIMESTONE

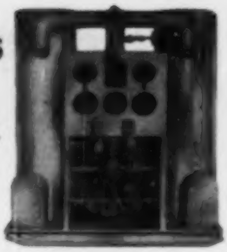
Almost any mineral can be economically pulverized with the Williams Roller Mill. Finenesses quickly changeable from 40 mesh to 400 mesh. All can be dried and ground simultaneously by introduction of hot air.

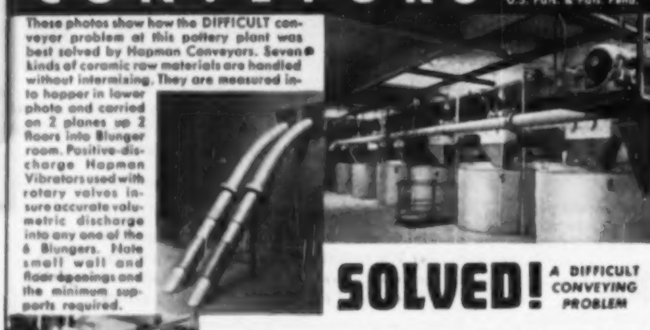
WILLIAMS ALSO MAKES . . .
Heavy-duty hammermills; impact and roller mills for 200 to 325 mesh grinding; drier mills; air separators; vibrating screens; steel bins; complete "packaged" crushing and grinding plants.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 N. NINTH STREET ST. LOUIS 6, MO.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS





Pettibone Mulliken Corp., Chicago, has acquired a complete line of hammermills and feed mills, since making Hammermills, Inc., St. Louis a wholly owned subsidiary.

Watertown Mfg. Co., Watertown, Conn., has gone into the powdered metallurgy field. It has acquired the physical assets of the Moulded Metals Co., Watertown.

Babcock & Wilcox Tube Co. plans to enter the field of limited fabrication of seamless and welded tubing. Types of fabrication will include bending, end forming, flash-butt welding.

Pennsylvania Crusher Co., Philadelphia, has acquired a line of hammer mills through the purchase of Dixie Machinery Mfg. Co., St. Louis.

NEW REPRESENTATIVES

Cyclotherm Corp. has appointed Flagg, Brackett & Durgin, Inc., Boston, to distribute its packaged type steam generators in New England. Phillips Engineering Co., Detroit, has been appointed for Michigan; Bingham and Risdom Co., Green Bay, Wis., for Wisconsin.

Chicago Eye Shield Co. has appointed Guardian Safety Equipment Co., Birmingham, Ala., its distributors for Alabama and Mississippi.

De Laval Steam Turbine Co., Trenton, N. J., has appointed Wilkinson & McClean, Ltd. of Calgary, Alberta, Canada, as sales representative for that province.

Ampco Metal, Inc., Milwaukee, has appointed Jaeger Welding Supply, Inc., Springfield, Mass., and Texas Welding Supply Co., Dallas, as franchised distributors in their respective areas.

Pulva Corp., Perth Amboy, N. J., has appointed Williams Sales Co., Cincinnati, Ohio, its exclusive representative covering Ohio, Michigan, Kentucky, West Virginia and Western Pennsylvania.

Blackmer Pump Co. has appointed the following distributors: Blott-Robb Co., Transmission Machinery Co., Amco Corp., Chicago; H. O. Link Co., Baltimore; Tri-State Equipment Co., Kansas City; Avels Sales and Engineering Co., Indianapolis. —End

WATER TURKEY OR SNAKE BIRD

Quotes, Extracts and Digests

MORGAN M. HOOVER, *Assistant Editor*

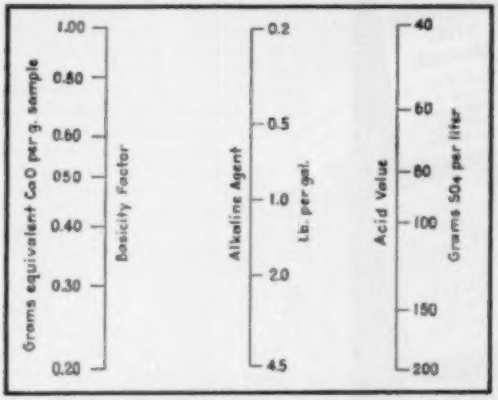


Fig. 1—Nomograph for finding the pounds of alkaline agent needed for the neutralization of one gallon of acid waste.

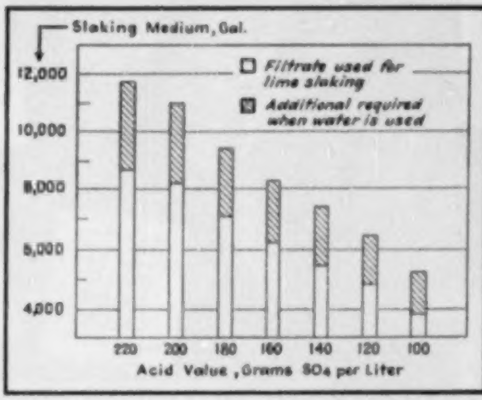


Fig. 2—Savings in total volume of liquid when filtrate is used as the slaking medium. Based on 20,000 gal. of acid waste.

$25,000 Lime Neutralization Plant

Wallace E. Wing

NOTE: *This paper concerns itself with steel mill waste liquor. However, most of this liquor is, at the present time, very similar to titanium pigment plant waste liquor and any method of handling would be generally similar. Slow filtering rates and difficult sludge disposal problems have plagued lime neutralization investigations. These difficulties have apparently been largely overcome in the work described here.*—EDITOR.

THE PLANT was at first considered to be of small capacity, nothing more than a pilot plant. However, we discovered the plant has sufficient capacity to treat successfully about 15,000 gal. of waste pickle liquor per day, or is adequate for the treatment of pickle liquor wastes from all except the very large steel fabricating plants. This pilot plant could be reproduced at a cost estimated at $25,000.

Our results point to an effective, economical method for precipitating and removing most of the dissolved salts in the acid waste. The filtrate remaining is water clear, slightly alkaline, and acceptable for discharge into most rivers and streams. The precipitate or sludge is removed on a continuous filter in the form of a relatively dry filter cake which is dry enough to be handled without trouble on most any type of conveyance.

The plant consists of five cypress tanks, a Duriron pump, a circulating pump, a 1 ft. x 3 ft. rotary vacuum string filter with the necessary auxiliary equipment. There are two 6 ft. x 6 ft. 1,275 gal. cypress tanks, one of which is used for the storage of acid waste pickle liquor and the other as a reactor tank (equipped with agitator). There are also three 4 ft. x 4 ft. tanks of 275 gal. each, two of which are used for effluent storage and the other for slaking lime or for dry lime feeding. This latter one is also equipped with an agitator. A small Duriron pump is used to pump the acid waste into the storage tank from a tank truck especially equipped for the purpose. A Wilfley pump is employed for circulation during neutralization and for handling the slurry to the filter. After precipitation on a FEINC 1 ft. x 3 ft. rotary vacuum string filter which has a filter area of 9.4 sq. ft., the slurry is filtered.

Some laboratory work is necessary before starting a neutralization run. First, the acid value of the waste to be treated must be determined. Then, the basicity factor of the alkaline agent must also be calculated. In these calculations the procedure reported by Hoak, Lewis, and Hodge of Mellon Institute in their paper, "Basicity Factors of Limestone and Lime" was followed. Their nomograph, shown in a simplified version (Fig. 1), makes it possible to determine the amount of alkaline agent (lime in this case) required to neutralize a given amount of acid. The acid value is determined by titrating a 5 ml. sample of pickle liquor with an excess amount of 0.5N NaOH precipitating the iron and removing it by filtration. The filtrate is then titrated with 0.5N HCl to a phenolphthalein end point.

With these data it is simple to calculate the acid value in terms of grams sulphate ion per liter, which gives the acid value in the nomograph. The basicity factor of the lime is determined by titrating one gram sample of alkaline agent with an excess of 0.5N HCl, boiling the sample for 15 min. and back titrating with 0.5N NaOH to a phenolphthalein end point. The basicity factor is expressed as grams equivalent CaO per gram of lime. This provides two points on the nomograph from which a line can be drawn, and the intersection at

(Continued)

QED, cont . . .

the middle scale indicates how much alkaline agent is required in pounds per gallon to neutralize the acid waste. This is the starting point for lime neutralization.

DRY LIME TREATMENT

Plans were made to use all of the readily available forms of lime which consisted of high calcium pulverized quicklime, high calcium hydrate, pulverized dolomitic quicklime, and dolomitic hydrate. From the standpoint of economy, the hydrates usually eliminate themselves. The quicklime has the advantage of generating some heat, which reduces the reaction time and increases the filtering rate. Studies with high calcium quicklime in the pulverized form were begun by adding the dry powder directly to the acid waste which was agitated in the reactor tank. Our own experience in handling lime indicated that considerable difficulty would be encountered in feeding uniformly a small amount of finely pulverized quicklime. To overcome this difficulty, we developed a simple device consisting of a Syntron Feeder which vibrated the screen. By feeding the lime manually into a hopper over this screen it was possible to add the lime at approximately the correct rate and in the proper form. Obtaining satisfactory dispersion of the lime was important. Including the time needed for feeding the lime, it required a total of 2 to 3 hr. to neutralize 200 gal. of acid waste. This provided complete neutralization using slightly under 10 percent excess lime over that stoichiometrically required. We filtered these solids on the rotary vacuum filter with a fairly dry cake which could be readily handled.

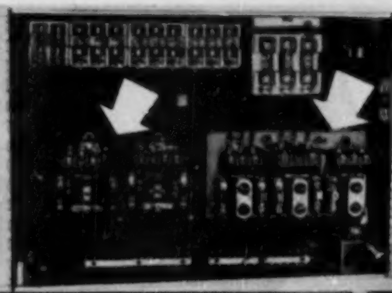
LIME SLURRY

Our interest in employing dry lime neutralization was predicated on the belief that the final sludge volume would be reduced and would be more readily filterable by maintaining the water solution at a minimum. However, it was decided to make a comparison between the application of lime in a dry state and in a slurry form.

In using lime in a slurry form, the slaking procedure required proper manipulation. Two pounds of lime slaked in 1 gal. of water gave us about the right consistency for treatment of the pickle liquor. The addition of water increased the final sludge volume considerably, which was an undesirable result since it complicated the disposal of the waste. However,

(Continued)

Central power and control panel for the AMF Ultramic Oven. Two A-B Bulletin 709 solenoid starters and three Bulletin 609 manual starters are installed. A-B controls find wide application in the equipment of many of America's leading manufacturers.



AMF Thermo-Radiant Multi-Cycle All-Purpose Oven, manufactured by the American Machine and Foundry Company, is equipped with A-B Bulletin 709 automatic and Bulletin 609 manual starters and Bulletin 800 push button stations.

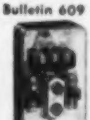
A-B Quality

Bulletin 709 Solenoid Motor Starters

A-B Bulletin 709 in general purpose enclosure.

A-B Bulletin 709 in Nema 4 watertight enclosure.

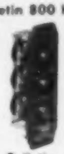
Bulletin 609 Manual Motor Starters



A-B Bulletin 609 in general purpose enclosure.

A-B Bulletin 609 in Nema 4 watertight enclosure.

Bulletin 800 Heavy Duty Push Buttons



A-B Bulletin 800 in general purpose enclosure.

A-B Bulletin 800 in Nema 4 watertight enclosure.

TROUBLE FREE A-B MOTOR CONTROLS for THERMO-RADIANT BAKERY OVENS

Wherever you find outstanding industrial equipment, today, you will find reliable A-B motor starters. Their simple, rugged construction provides millions of trouble free operations. The Bulletin 709 solenoid starter for remote control provides overload protection and no voltage release. For manual operation . . . Bulletin 609 with reliable overload breakers.

For normal industrial applications, A-B starters in general purpose enclosures are adequate. In wet, moist surroundings, A-B starters in Nema Type 4 watertight enclosures should be specified. See your nearest A-B control engineer, today.

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SOLENOID MOTOR CONTROL
QUALITY

QED, cont . . .

using the proper amount of lime with the correct excess over the theoretical, it was possible to produce a slurry of good filterability, which yielded a filter cake that was dry enough to handle easily.

The natural sequence of this operation called for reversing the operation, that is, adding the acid waste to the lime slurry. This produced very satisfactory results with a satisfactory neutralization reaction, an excellent filtering rate, and a fairly dry cake. The agitation of the lime slurry was augmented with a recycling of the slurry as the acid was being added so that the degree of turbulence in the reaction vessel was increased. In employing this method, complete reaction occurred by the time the final acid was added. In each case the completeness of neutralization in the reaction tank was checked by determining the pH. When a pH of 9 or higher was reached the reaction was considered complete. The filter cake (sludge) which was produced contained approximately 58 percent moisture, which was dry enough to be handled with ease. The resulting filtrate was clear.

FILTRATE UTILIZATION

Next, our attention was centered on the utilization of this filtrate for slaking the lime. In general, it was possible to use a sizable percentage of the filtrate for slaking the lime without affecting the reaction time adversely.

Fig. 2 reveals the savings in total volume of liquid when the filtrate is used as the slaking medium. In the extreme lefthand column of Fig. 2 where the acid value of the liquor reaches 220 g. SO_4 per liter, it is interesting to note that only 8,800 gal. of filtrate are required to slake the lime. If the same amount of lime is slaked in water alone, it will require 11,800 gal. of water. Looking at the extreme right of the chart, with a low acid value of 100 g. SO_4 per liter it requires only approximately 3,900 gal. of filtrate to slake the required amount of lime, while 5,200 gal. of water are needed to slake the same amount of lime. This emphasizes the savings in final waste volume when the filtrate is used as the slaking medium. The results which were obtained clearly demonstrate the advantage of slaking the lime with the filtrate from the standpoint of good filterability in addition to the reduced volume of filtrate. As an example, it was found possible to slake 3 lb. of lime per gal. of slaking medium in-

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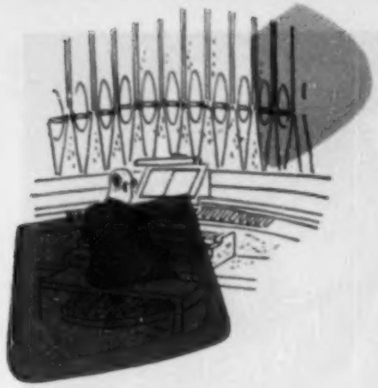

unusual flexibility . . . . .

Although it is but one instrument, the organ can reproduce a single musical pattern in a multitude of tones and varied effects. Sivyer offers the same unusual flexibility in castings. The composition, the characteristics of a casting . . . even though the pattern is the same . . . can be varied to suit a wide range of needs or conditions. This flexibility can mean extra economy, increased efficiency in many ways for the shrewd buyer of steel castings.

one casting . . .

IN A VARIETY OF ALLOYS

SIVYER

SPECIALISTS IN HIGH ALLOY AND SPECIFICATION STEEL CASTINGS

SIVYER STEEL CASTING COMPANY • MILWAUKEE ◇S◇ CHICAGO

ANY VOLUNTEERS?

"At every council table around which negotiations between labor and management are conducted, the consumer is the unseen, though deeply interested party, yet no one pleads on his behalf."

CHARLES SAWYER
Secretary of Commerce

QED, cont. . .

stead of 2 lb. per gal. when water was employed. This is credited to the deflocculation of the calcium hydroxide in the slurry. It is our opinion that the presence of calcium sulphate in the waste is largely responsible for this phenomenon. In addition, by using this lime slurry made from the filtrate a better, more readily filterable sludge was produced with a heavier and drier cake. It was also observed that the temperature of the acid waste greatly affected the reaction time and the filtering rate. The hotter the acid, the more rapid the reaction; and the higher the filtering rate, the lower the moisture in the filter cake.

Wallace E. Wing, Marblehead Lime Co., before the Fifth Industrial Waste Conference, Purdue University, Nov. 29 and 30, 1949.

EROSION

. . . *Synthetic Rubber*

E. M. Fettes and J. S. Jorczak

Pump casings and pipe fittings can be protected from the erosion of turbulent water by a new process in which powdered synthetic rubber is sprayed through a ring of flame.

The flame-spraying technique, developed for the Navy during the war, covers the metal with a molten rubber which fuses to a resistant coating.

Prior to development of these coatings, expensive equipment had to be completely replaced when cavitation progressed beyond a certain point.

The coating absorbs the shock and the rubbery properties distribute the force. The coating itself is not subject to erosion.

With the improvements in the spray powder and in the methods of application perfected during this last year, the technique appears suitable for industrial applications.

The basic composition used for coating is a tough rubber-like powder which is chemically stable when exposed to a wide range of solvents and is specially effective in salt water exposure. The product is applied by using a controlled flame melting the powder just prior to depositing it on

(Continued)

LA PRIMADORA, CORONA CORONA??

"I have asked many business executives how they make up their minds whether to require a two-year or four-year payoff on new equipment, or their equivalent, a 50 percent or a 25 percent return, and I have yet to get an adequate rationalization of their positions. They appear to have their favorite payoff requirements or rates of return just as they have their favorite cigars."

George Terborgh, *Research Director Machinery and Allied Products Institute*

QED, *cont. . .*

the steel surface. The coating is actually fused to the steel surface and it is bonded so firmly that it is extremely difficult to remove the coating once it has cooled to normal temperatures.

The application equipment resembles a welding torch but has controls for flow rates of gases and the powder. The powder is delivered as a stream passing through a ring of flame. The powder becomes liquid at contact with the flame and fuses to an impermeable film on the steel. The steel surface is prepared for the coating by sandblasting, and the surface to be coated is preheated with the flame prior to release of the powder. The film is built up with successive passes until the coating is about $\frac{1}{16}$-in. thick. The fused film has properties between those of a hard plastic and those of a tough rubber.

E. M. Fettes and J. S. Jorczak, Thiokol Corp., before Division of Industrial and Engineering Chemistry, American Chemical Society, Houston, Tex., March 29, 1950.

EQUIPMENT CLEANING . . . *Better Method*

T. E. Purcell and S. F. Whirl

Inhibited phosphoric acid removes rust and mill scale from new boilers, and water-formed insoluble deposits from serviced units, without the limitations and adverse effects associated with inhibited hydrochloric acid.

The principle advantage of phosphoric over hydrochloric acid is that it can be boiled in the unit by direct firing of the boiler with negligible attack of the metal. This is possible because the inhibitor is effective at these temperatures. In addition to the beneficial washing action, the resulting natural circulation promotes distribution and provides a sufficiency of acid at the desirable locations at all times. Furthermore, the boiling operation sends solutions into certain regions at the top of the boiler which

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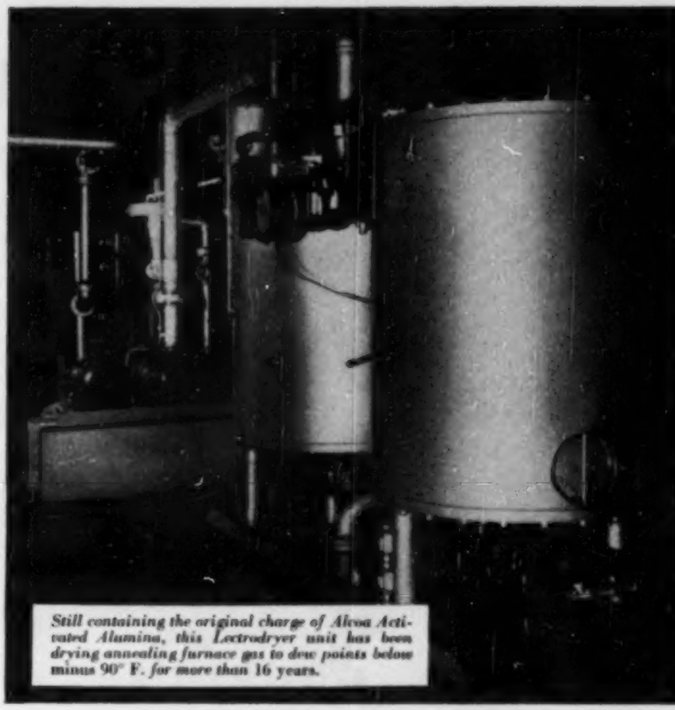
Carnegie-Illinois Steel Corporation maintains extreme dryness in furnace atmospheres



Still containing the original charge of Alcoa Activated Alumina, this Lectrodryer unit has been drying annealing furnace gas to dew points below minus 90° F. for more than 16 years.

with ALCOA Activated Alumina

In the manufacture of USS silicon steel products at Vandergrift, Pa., Carnegie-Illinois Steel Corporation uses great care in the control of annealing-furnace atmosphere. The absence of moisture in the gas is as important as its composition. Therefore *reliable* drying equipment and a *reliable* drying agent are essential.

With ALCOA Activated Alumina, Carnegie-Illinois Steel Corporation dries furnace gas to dew points below *minus 90° F.*

The drying unit illustrated was *installed over 16 years ago, and still contains the original charge of ALCOA Activated Alumina!*

Day in and day out, this unit has been drying 15,000 cu. ft. of gas per hour, on a 12-hour cycle. Each of the two towers contains 1,500 lbs. of ALCOA Activated Alumina. Gas enters the towers at 50° F. to 90° F. Regeneration temperature is approximately 350° F.

During the 16-year period, the one charge of ALCOA Activated Alumina has dried more than 1,971,000,000 cubic feet of gas. This means that each pound of alumina has dried 657,000 cubic feet.

High resistance to shock, abrasion and erosion, plus the fact that reactivation may be repeated an almost unlimited number of times are reasons why ALCOA Activated Alumina can be depended on for so many years.

If you want a stable, reliable and *economical* agent for drying gases, vapors or organic liquids, let us give you *all* the facts about ALCOA Activated Alumina. Write to: Aluminum Company of America, Chemicals Division, 602G Gulf Building, Pittsburgh 19, Pa.

Alcoa Chemicals

ALCOA ALUMINUM

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM

THE POLITICAL OCTOPUS

"Once the dead hand of politics gets its convulsive grip on American business and industry, free competition will be strangled, and our economic system will be no different—and no more successful—than those noble experiments which are crumbling into dust in Europe."

BENJAMIN F. FAIRLESS, *President*
United States Steel Corp.

QED, cont. . .

otherwise could not be reached except by recirculation with an elaborate system of internal baffling.

By contrast, inhibited hydrochloric acid can be used only at temperatures below 150-165 deg. F. Above this temperature, the effectiveness of the inhibitor decreases with progressively more severe attack of the boiler metal. With hydrochloric acid, the acid cleaning process must therefore consist either of soaking, or recirculation with external heating.

External heating by steam jets or heat exchangers increases the complexity and the cost of cleaning operation, while attempts to utilize the sensible heat of the furnace and boiler without recirculation would introduce hazards of imperfect mixing, acid excess or deficiency, corrosion due to hot spots and the possibility of inadequate cleaning.

Other advantages are the greater stability of phosphoric acid which eliminates the corrosive and fume problems of hydrochloric acid, and the rust resistant surface left by the use of phosphoric acid.

Even at room temperature, hydrochloric acid vapors leave the solution. As the temperature is increased to that encountered in boiler cleaning, the rate of decomposition becomes appreciable. Since the inhibitor remains in the solution, its benefits do not extend to the vapor; thus the metal surfaces of drum, safety valves, boiler and superheater tubes above the level of the cleaning solution are exposed to corrosive uninhibited hydrochloric acid.

While the valves may be protected by their removal and superheaters by filling with condensate or isolation, there are always some regions that are beyond protection. During the cleaning operation with hydrochloric acid, invariably, HCl vapors pervade the plant atmosphere. These fumes are not only corrosive to power plant equipment, meters and exposed metal work, but also are toxic to plant personnel.

It was found that a five percent inhibited phosphoric acid solution boil-

(Continued)

ing at atmospheric pressure gave good deposit removal, negligible attack of metal and a surface resistant to rusting.

T. E. Purcell and S. F. Whirl, Duquesne Light Co, before the American Society of Mechanical Engineers, St. Louis, June 22, 1950.

SHALE OIL

. . . *Becoming Competitive*

E. D. Gardner, E. M. Sipprelle, Boyd Guthrie and L. W. Schramm

Recent developments in mechanized mining at the U. S. Bureau of Mines oil-shale mine near Rifle, Colorado, have lowered mining costs to 29c. per ton of shale. This is considerably less than previous estimates and means correspondingly lower production costs of synthetic liquid fuels made from shale oil.

The cost of producing crude shale oil from 30 gal. per ton shale, using the new mining and processing techniques, would be about $1.50 per bbl. This includes estimated out-of-pocket operating costs and depreciation but not income taxes or profit. A year ago a Bureau of Mines estimate, excluding interest on investment and profit, was approximately $2 per bbl.

At that time it was estimated that the cost of gasoline, diesel oil and heating oil made from the crude shale oil would be about 8.4c. per gal. The sharp rise of petroleum crude in the last few years due to the increased difficulty of finding new petroleum, together with the technological advances in mining and processing oil shale and refining shale oil is bringing the cost of liquid fuels from petroleum and liquid fuels from oil shale close to the same level.

If present trends continue, it will not be long until shale oil can supplement petroleum at a comparable price. The Green River Formation includes the richest known deposit of oil shale in the country. It is estimated that 300 billion barrels can be produced from a 500-ft. thick measure of this formation over a 1,000 sq. mi. area of northwestern Colorado.

From a high-grade section 60 to 100 ft. thick occurring near the base of the 500-ft. measure, it is estimated that 100 billion bbl. of shale oil could be produced from the same area. This section is called the Mahogany Ledge and is the one in which the bureau's oil-shale mine is located.

The equipment developed for exploiting the Mahogany Ledge includes unique four-drill jumbos for drilling

(Continued)

QED, cont . . .

heading and bench rounds, a portable 1,500 cfm. utility compressor station, a mobile platform from which to charge blast holes, and a mobile telescopic platform from which it is possible to inspect any position on the pillar walls or roofstone from 5 to 70 ft. high. A standard three-yard electric shovel with a shortened boom and 15-ton diesel trucks are used for loading and transporting the broken shale from the mine.

E. D. Gardner, E. M. Sipprelle, Boyd Guthrie, and L. W. Schramm, Bureau of Mines, before the American Society of Mechanical Engineers, St. Louis, June 22, 1950.

CONSTRUCTION

. . . . *Future Wars*

A. Allan Bates

Civilization's best chance of surviving an atomic war is to make maximum use of concrete in building its towns and cities.

Reinforced concrete structures, properly designed, possess a unique combination of impenetrability to deadly atomic radiation, resistance to blast destruction, safety against fire, and last but not least, economic feasibility.

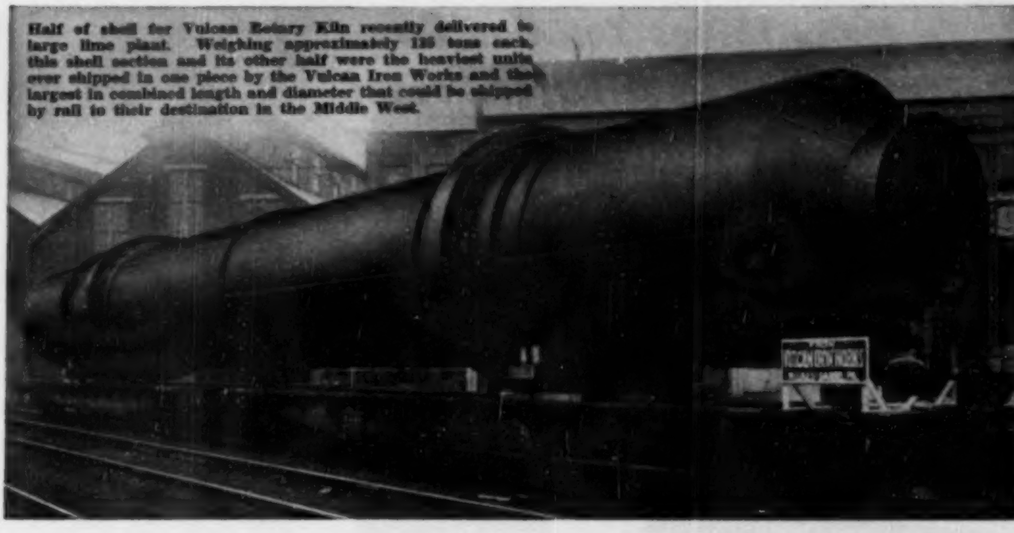
Physically, we know that practicable concrete shelters can be designed to resist the effects of all but a very close hit by an atomic bomb. Engineering estimates plus studies of results of atomic attack in Japan show that fairly adequate protection for a majority of our city dwellers during an atomic attack can be provided behind concrete walls for an expenditure only moderately greater than the cost of heavy-duty factory construction.

It is true that a more or less complete dispersal of all of our cities, together with adoption of a policy of putting our principal factories and offices and most of our apartments underground would give us the greatest immunity against atomic attack. But this would be incredibly expensive and politically impossible. Nothing less than an all-out atomic war with its certain destruction of our civilization would convince our people that they should have adopted such measures.

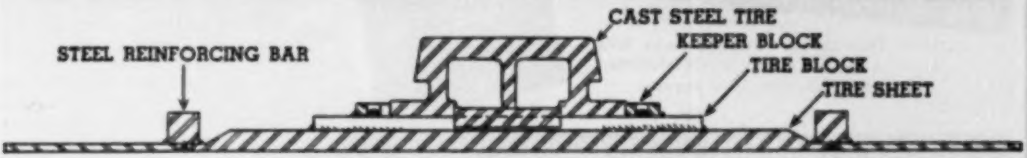
Meanwhile, the extensive and well planned use of reinforced concrete in construction of our new buildings and strengthening parts of our old ones in or near cities will minimize the necessity of burrowing underground or of dispersing our centers of population.

No precautions that can be taken will make atomic warfare other than what it is—an indescribable nightmare of horror, death and destruction. We

(Continued)



Half of shell for Vulcan Rotary Kiln recently delivered to large lime plant. Weighing approximately 125 tons each, this shell section and its other half were the heaviest units ever shipped in one piece by the Vulcan Iron Works and the largest in combined length and diameter that could be shipped by rail to their destination in the Middle West.



THIS PATENTED RIVETLESS TIRE MOUNTING Cuts Maintenance Costs on Vulcan Rotary Kilns

The longer a Vulcan Rotary Kiln is operated the greater the savings secured—because of its very low costs for maintenance and repairs. Fifty years of continuous experience in the design, manufacture and servicing of this type of equipment has taught our engineers where operating troubles are most apt to occur and how to prevent them.

A typical example of Vulcan Trouble-Preventing Kiln Construction is the patented rivetless tire mounting shown above. Not only does it completely eliminate the rivet-popping once considered inevitable but its distinctive combination of interlocking lugs and blocks absolutely prevents creeping of the tire in any direction.

Another important advantage is the use of ONE THICK PLATE beneath the tire, instead of several relatively thin plates, thereby improving heat-conductivity and overcoming the former tendency toward burning or bulging of the shell and reinforcing bands at these particular points.

Write us regarding any manufacturing or processing problems within the scope of the equipment listed below. No charge or obligation for estimates, constructive suggestions and preliminary designs.

VULCAN IRON WORKS

Established 1849

Main Office and Works **WILKES-BARRE, PA.,** New York Office 50 Church

Rotary Kilns, Coolers and Dryers	Toothed, Double-Roll Crushers	Heavy-Duty Electric Hoists	Steam Locomotives
Rotary Retorts, Calciners, Etc.	High-Speed Hammer-Type Pulverizers	Self-Contained Electric Hoists	Diesel and Gasoline Locomotives
Improved Vertical Lime Kilns	Ball, Rod and Tube Mills	Scraper-Loading Hoists	Diesel-Electric Locomotives
Automatic Quick-Lime Hydrators	Shaking-Chute and Chain Conveyors	Cast-Steel Sheaves and Gears	Electric Locomotives and Larrys

QED, cont. . .

cannot construct practicable buildings to resist direct or very near hits by "ordinary" atom bombs. Therefore any city built above ground can be wiped out by a sufficient number of atomic bombs. The suggestions which I have made will only increase the probability that any individual or group will live through an atomic attack. The sufficient and wise use of reinforced concrete construction will materially increase the numbers of such survivors.

A. Allan Bates, Portland Cement Association, speaking at the dedication of the Association's new research and development laboratories, Chicago, June 8, 1950.

RUBBER

. . . *Synthetic Carcasses*

Carl S. Marvel

The American tire industry's dependence on natural rubber imports from the Far East may be ended by a modified synthetic rubber for tire carcasses which has been developed at the University of Illinois.

The new kind of synthetic rubber, or copolymer, shows great promise as a material for tire carcasses—an application in which natural rubber is still used because all previously known types of synthetic rubber build up too much heat in service. Synthetic rubber has proved satisfactory for both tire treads and inner tubes.

This copolymer is extremely interesting because it shows the lowest heat build-up of any of the synthetic rubbers and is approximately equal to natural rubber in this respect. It seems probable it may prove to be a useful carcass stock rubber, and the preliminary facts bear out that notion.

A replacement of natural rubber for use in the carcasses of tires is needed to make the United States independent of the Far East for its rubber needs.

Still further tests are needed before it is definitely established that this polymer will make good tire carcasses. The copolymer is made of butadiene and styrene by a process employing sodium as a catalyst.

Carl S. Marvel, University of Illinois, before the Chicago Section, American Chemical Society, Chicago, May 20, 1950.

OIL

. . . *and Water Treatment*

Joseph N. Breston

Billions of barrels of oil will be added to the nation's reserves through the application of improved techniques for secondary recovery by water flooding.

(Continued)

QED, cont. . .

The treatment, requiring only 1 to 6 lb. of a single chemical for every million pounds of water, has averted the abandonment of many oil wells which were close to the limit of economic production.

Two classes of chemicals are used. They are high-molecular-weight alkyl and aryl amine-type compounds, and certain ethylene oxide-amine condensation products.

Except for filtration, no other treatment is necessary. The chemicals used are capable of being adsorbed onto the pipe surface in very thin protective layers. Thus, in addition to being very effective bactericides they are also practical corrosion inhibitors.

Such water treatment has been tested on many oil leases by the Quaker State Oil Refining Corp. and other producers in the Bradford field and has proved very successful. Besides cutting down on the cost of water treatment and general maintenance of the water distribution system, there is a definite indication of increased oil production.

The secondary recovery of petroleum by water flooding involves the injection of water under very high pressures into specially drilled wells. The water is forced into the porous oil sandstone where it pushes the oil ahead of it and into the oil wells which are drilled about 200 ft. away.

Since the pores or openings in the sandstone containing the oil are as little as one ten-thousandth of an inch in diameter, it is very important that the water be extremely clean. The most minute particles of dirt or even bacteria can easily plug these oil sandstone pores and prevent the entry of water. Thus, it is important that the water used for flooding be treated so it will be non-corrosive, free of bacteria and very clear.

Joseph N. Breston, Pennsylvania Grade Crude Oil Association, before the Division of Petroleum Chemistry, American Chemical Society, Houston, March 27, 1950.

PETROCHEMICALS

. . . Look Ahead

Gustav Egloff

The petrochemical industry, which was initiated only 25 years ago, now produces about 12 billion lb. of chemicals annually. Indications are that it may reach 48 billion lb. by the year 2000 and at the same time will be utilizing only 1 percent of the projected petroleum and natural gas production. These predictions are based on present demands for petrochemicals and the development of new products. Continued expansion is assured by the

(Continued)

QED, *cont.* . .

reliance of petroleum companies on research. Over $110 million is spent annually on petroleum research.

Most of the alcohols and many other high tonnage chemicals are now produced from petroleum and natural gas. Many new products have been developed such as synthetic glycerin which is important not only in meeting present demands but also as a potential source of synthetic fats to augment food supplies.

Scientifically practiced agriculture offers unlimited market for fertilizers, insecticides, soil fumigants and weedkillers. The products already developed have increased crop yields and even restored depleted farm lands to production.

The plastics industry has grown 600 percent in the past 10 years and could easily increase 25-fold in the next 50. Demand is in excess of supply for many products and new ones are continually being developed.

The synthetic rubber industry which is largely based on petroleum will increase despite availability of natural rubber. Synthetics are being improved and entirely new products better suited to many uses than the natural rubber will be developed.

Nylon is increasingly dependent on petroleum and natural gas for raw materials. New textiles such as orlon from acrylonitrile necessitate increasing petrochemical production.

The petroleum industry is a major supplier of raw materials to the detergent industry which has reached 1 billion pounds annual production and is expanding.

One of the largest future markets for petrochemicals is aromatics such as benzene. The maximum quantities available from coke-oven operation are now being produced but demands are not being met. All increases in supply will necessarily come from the petroleum industry.

The present investments in petrochemical plants exceed $1 billion and a $500 million expansion is taking place. This enormous expenditure attests the faith of oil and chemical industries in the future of petrochemicals.

Gustav Egloff, Universal Oil Products Co., before The American Institute of Chemists, New York, May 12, 1950.

NEW PROCESS

. . . *Hydrogen Peroxide*

G. L. Putnam and J. F. Sullivan

A new process for hydrogen peroxide makes use of large amounts of waste hydrogen, produced as a byproduct

(Continued)

QED, *cont. . .*

of the electrochemical industry, and oxygen from the air.

The method involves the mixing of about twenty parts of hydrogen gas with one part of oxygen, heating and passing through the mixture an alternating electric current at 5,000 to 15,000 v.

The inherent characteristics of this process indicate its promise as a feasible method for hydrogen peroxide production.

About 15 kwh. of electrical energy are required per pound of hydrogen peroxide, but recently developed phosphate type glass equipment will probably lower the energy requirement greatly.

G. L. Putnam and J. F. Sullivan, University of Washington, before the Pacific Northwest Regional Meeting, American Chemical Society, Richland, Wash., June 9, 1950.

LUBRICANTS

. . . From Olefins

F. M. Seger, H. G. Doherty, and A. N. Sachanen

A new high-quality synthetic lubricant, made from abundant raw materials such as coal, oil shale, and refinery byproducts, boasts quality standards not obtainable from petroleum oils without elaborate procedures.

Most of the crude oils now available contain lubricant fractions of lower quality than those previously used. Coupled with this trend is the demand for even better lubricant performance under severe operating conditions.

In the synthetic process, an intermediate chemical called 1-decene is produced from coal or one of the other raw materials, and 1-decene in turn is converted into an excellent synthetic lubricant by a simple heat treatment in conventional refinery equipment.

Silicones and certain fluorine compounds have been used for special lubricant applications, but there is no prospect of their extensive use in the general markets for motor and indus-

(Continued)

SAFE INVESTMENTS

"Steam-electric power plant installations being made in this country and abroad will have served their economic life before there will be such widespread use of atomic fuel as to make them obsolete before their economic life is out."

WALKER L. CISLER,
Executive Vice President
Detroit Edison Co.

QED, *cont . . .*

trial oils, which consume a total of several million tons a year. Synthetic oils produced from coconuts and soy beans in Japan during the war have proved uneconomical in peacetime, and the high quality lubricating oils produced from coal in Germany have the disadvantage of requiring the use of an extremely reactive chemical catalyst.

A similar conversion has been accomplished in the present work by means of heat, without the use of a catalyst.

Previous investigators have studied this non-catalytic process for the production of fuels, but they did not disclose whether the higher polymers, if formed at all, were good lubricants.

The new product's viscosity index of 140 and pour test of minus 10 deg. F. are qualities now obtainable only in the premium-priced petroleum oils.

The best conditions for polymerization are 650 deg. F. and 10 hours' time. The use of moderately low pressure is a distinct advantage in the design of equipment and contributes to the practicability of the process.

It is not now practical to produce decene or its equivalent. The preparation of large quantities of lubricants by synthesis remains as an alternate supply to be used at some future time of petroleum shortage.

F. M. Seger, H. G. Doherty, and A. N. Sachanen, Socony-Vacuum Oil Co., before Division of Petroleum Chemistry, American Chemical Society, Houston, March 27, 1950.

INDUSTRY

. . . *Billions, not Nickels*

Roy C. Ingersoll

A friend of mine, an only child, was raised in a rather poor home in a rather poor neighborhood in a small town in northern Indiana. But there was one bright spot in the picture—or at least my friend thought it was a bright spot.

In a big white house on a hill at one end of town there lived an uncle. He was a kindly, indulgent, apparently well-to-do uncle. Whenever my friend needed a nickel or a dime or a quarter for soda pop or red hots or the corner movie, Uncle was a soft touch.

As a result, my friend behaved differently than the other boys in this rather poor neighborhood. While one would earn a dime by mowing a neighbor's lawn, my friend would sit on the door-step and whittle. While another

(Continued)

MORE POWER TO YOU

"To improve present-day high octane gasoline, refineries are constantly seeking better methods to obtain the maximum percentage of aromatic hydrocarbons from each barrel of crude oil. The trend is definitely toward aromatics, even though they are expensive to make."

Fred Preu, *Assistant Manager, Special Products Department, Shell Oil Co.*

QED, cont. . .

would earn pocket money by hauling ice from the ice house a few blocks away or by washing windows or white-washing fences, my friend would run up the hill to put the bee on Uncle.

He became the most shiftless boy anyone had ever seen. Even his own mother couldn't get him to do the simplest chores around the house. There was no incentive. Instead, there was always Uncle.

One day Uncle died. Being a kindly, indulgent uncle, no doubt he was welcomed in heaven. The bottom fell out of my friend's boy world. Uncle hadn't been as well-to-do as people had supposed; he died broke.

No nickels and dimes any more. So—no soda pop nor red hots, either. After awhile my friend began to look around him—for errands to be run and for chores to be done that would bring in the nickels and dimes. Incentive had replaced indulgence.

This friend of mine later worked his way through college, and today is a prosperous and respected lawyer in Chicago. He got on the beam once he no longer could run to Uncle.

In this we have a parable. For today the American people by the hundreds, by the thousands, by the millions are running to another Uncle named Sam. And they are running with their hands outstretched, palms upward—not for nickels and dimes, but for millions and billions of dollars.

Roy C. Ingersoll, Borg-Warner Corp., before the Rotary Club, Kalamazoo, Mich., April 24, 1950.

INDUSTRY

. . . *Better Understanding Through the Ranks*

E. B. McConnell

You cannot go outside the company and buy a canned program for better understanding back and forth through the ranks. The men who prepare your material must have a thorough background in the company's opera-

(Continued)

Modern Handling Methods with ESSO SOLVENTS

Esso Solvents are handled by the most modern methods. Separate refining, storage, and shipping facilities assure you pure, *uniform* solvents . . . *prompt, efficient delivery.*

YOU CAN DEPEND ON ESSO SOLVENTS FOR

- **MODERN HANDLING METHODS** — separate tank storage, pumping lines, tank cars and trucks, are used in all Esso Solvent handling operations.
- **MULTI-STORAGE AVAILABILITY** — Water terminals in many industrial centers.
- **UNIFORMITY** — made in modern refineries from carefully selected crude oil sources.
- **ECONOMY** — closely controlled quality gives constant, efficient industrial processing, high-quality products.
- **CONTROLLED EVAPORATION** — available in a wide range of evaporation rates with precise characteristics to meet your requirements.
- **SOLVENCY** — Esso aliphatics and Solvesso aromatics cover both high and low solvency ranges.

Controlled high quality produces large profits with versatile, dependable Esso Solvents

Esso

PETROLEUM SOLVENTS

SOLD IN Me., N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

ESSO STANDARD OIL COMPANY — Boston, Mass. — New York, N. Y. — Elizabeth, N. J. — Philadelphia, Pa. — Baltimore, Md. — Richmond, Va. — Charleston, West Va. — Charlotte, N. C. — Columbia, S. C. — Memphis, Tenn. — Little Rock, Ark. — New Orleans, La.

FOR TECHNICAL ASSISTANCE

If you have a solvents problem or want further information on the specifications and characteristics of Esso Solvents — write or call our office nearest you. Our technicians will be glad to assist you.

QED, cont. . .

tions and a complete understanding of the problems involved. Another thing we have learned is that communication by personal contact is by far the most effective means we have for promoting understanding.

At the outset of the company's program for training supervisors in the manufacturing department, supervisors through no fault of their own were not functioning well as a passageway for two-way communication by personal contact. Many of them had not been impressed with their importance as key men in the communication system and top management had not fully appreciated their importance in this function.

A survey of employees by an independent agency disclosed three important facts: (1) 70 percent of all employees wanted more information about the company; (2) employees ranked supervisors fourth as the source of most of their information about the company, and (3) employees by a large margin would like to get their information from supervisors.

Following these investigations, management set up a program of three-day seminars, limited to 20 men each, and extended to both operating and technical staff in a series of 14 meetings.

Seminars were held in the home office, and were designed to give each supervisor an acquaintanceship with top management men from all departments. The seminars were pointed toward demonstrating to supervisors the importance of good management and human relations, and they stressed the role of supervisors as the go-between in management-worker relations.

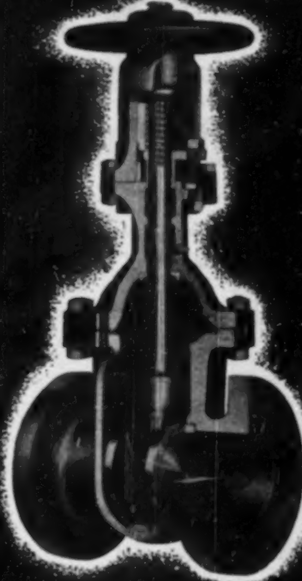
Among several benefits of the program is the discovery by supervisors that the top management group is not mysteriously tucked away in an ivory tower, but is composed of friendly hard working men with a broad knowledge of the petroleum industry.

The program, in addition, has inspired supervisors to pass along information desired by employees during their on-the-job contacts, with the results that they have been surprised at the number of opportunities they have each day to get the information down to employees. When things come up in a natural manner they are more convincing. It is easier to see the application and purpose when information is given out in small parcels that relate directly to the work or the subject being discussed.

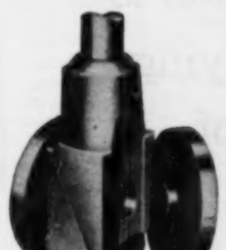
E. B. McConnell, Standard Oil Co. (Ohio), before the American Petroleum Institute, Cleveland, May 3, 1950.

—End

How Darling features prevent trouble and expense



UNIFORM WEAR DISTRIBUTION



A LARGE percentage of valve leaks, lost time, expense, can be blamed on uneven wear—the uneven wear caused by repeatedly exposing the same disc and seat areas to concentrated pressure, fluid flow, and resultant galling from operation.

For years such leaks were considered the result of normal, expected wear. But the unique design of Darling Double Disc Parallel Seat Gate Valves has proved that uneven wear can be prevented. The two valve discs shown in the cutaway view, and again in the removed inside assembly, are separately and independently hung and free to revolve through their 360°. Valve operation aids the action during the lowering and raising of the disc assembly. The discs never seat twice in the same position and obviously wear is bound to be uniform. This results in tight closure even when the disc faces are worn.

Hundreds of Darling gate valve users have learned by experience that uniform wear distribution results in longer service life and correspondingly lower maintenance cost.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.

*This advertisement is one of a series showing how the unique Darling Fully Revolving Double Disc Parallel Seat Gate Valves answer the following critical operating problems:

- Positive, easy closing—regardless.
- Automatic adjustment for valve body distortion.
- Elimination of disc-to-seat friction and galling.
- Uniform wear distribution.
- Extreme simplicity.
- Greater service life.
- Simplified maintenance.

CORROSION RESISTANT VALVES

In addition to conventional iron bronze and steel constructions, Darling specializes in valves for any corrosive fluid: iron body valves with special alloy trim; iron body, rubber lined, with special alloy trim, all bronze, and all special alloy. Darling's 50 years of experience in meeting unusual requirements is always at your service.

Outline your service requirements and get complete information on Darling Valves of the proper type. Or, send for the complete 300-page Darling Catalog No. 17M. It describes Darling Valves of all types for every normal or unusual service, and for pressures up to 1500 pounds. It's full of helpful information... Yours for the asking.

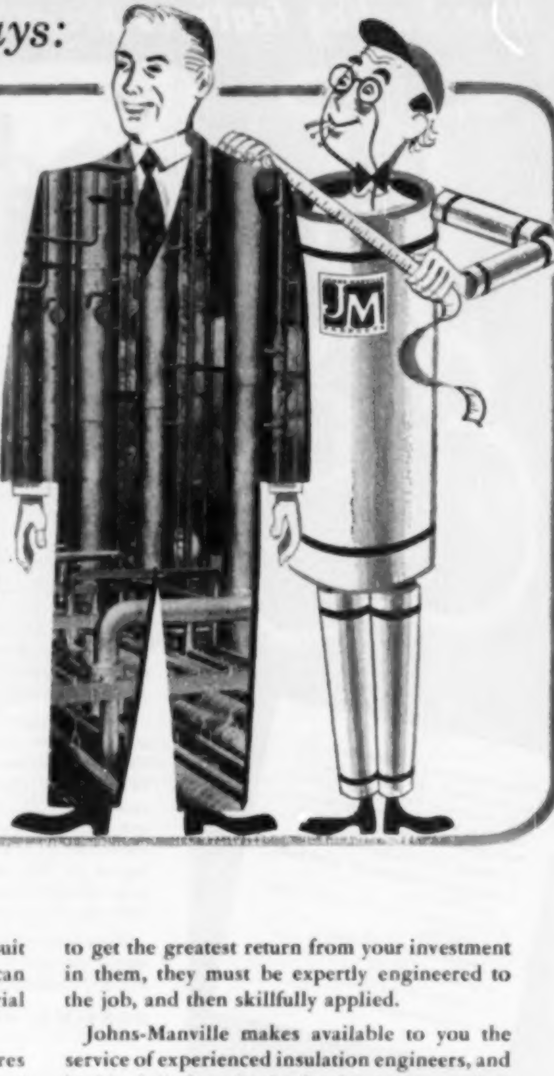
DARLING
TRADE DARLING MARK
VALVES

THE VALVE MARK OF QUALITY . . . WATCH FOR IT

Mr. Insulation says:

"Buying insulation is like buying a suit of clothes:

—the better the materials; the more expert the tailoring, the better your investment"



Just as no one cloth can be used for every suit of clothes, there is no one raw material that can serve as the ideal insulator for every industrial insulation job.

For this reason, Johns-Manville manufactures a wide variety of industrial insulations—of asbestos and other raw materials—each of which is designed for a special purpose. These insulations span the entire range of temperatures from 400 F below zero to 3000 F above.

But, again, there is much more to the story of insulations than their manufacture. In order to get the greatest return from your investment in them, they must be expertly engineered to the job, and then skillfully applied.

Johns-Manville makes available to you the service of experienced insulation engineers, and highly skilled mechanics for the proper application of Johns-Manville insulations.

If you are contemplating an insulation installation for your plant, it will pay you to look into this Johns-Manville insulation service. For further information just write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**

Chemical Engineer's Bookshelf

LESTER B. POPE, Associate Editor

Lesson Two in Book Publishing

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY. Vol. 5: Di- to Explosives. Edited by Raymond E. Kirk and Donald F. Othmer. Assistant editors: Janet D. Scott and Anthony Standen. Interscience Encyclopedia, New York. 992 pages. $20.

Last month I told you how to revise a reference book on electrochemical engineering. This month's recipe explains how to compile a technical encyclopedia. (It is assumed that you have one basic ingredient—a publisher with faith and money.) Here, then, are the steps: (1) List the subjects to be included. (2) Get some outstanding authority to promise to write all or part of each. (3) Have his work checked by a competent reviewer. (4) Edit the manuscripts, send them to the printer, proofread.

There are pitfalls along the route outlined. Let's take a look.

Subjects—No matter how complete or comprehensive you think your list is, you will have to add to it. Some of your authors will cover their assignments incompletely. In the earlier letters of the alphabet you will have a second chance. For example, if your Lignin author doesn't come through, put in a cross reference to Pulp and Paper. Keep a record so you don't forget these cross references. Be careful. By the time you get to Zinc and Zirconium you won't have any second chances.

Authorities—Line up your writers and get them to work. The earlier the better because a few will let you down. They will promise, but not produce; they will write, but will be wrong. So you need time to corral substitutes.

Reviewers—You can't know everything, so you ask experts to check the experts. There are two desirable features to this system. First, obviously, you increase accuracy and completeness. Second, if writer-expert X plugs X company products, reviewer-expert Z will surely point out that Z company products should be included.

Editors—One of your chief rewards is going to be the satisfaction that comes from a job well done. Users of your encyclopedia will never realize nor stop to consider your efforts. They see authors' names on the various articles. Readers will never know how much of each one is your work. With a large list of authors, it is inevitable that a few articles will be unreadable. With several authors on one subject, you will have to tie the whole subject together. Your readers—users of your encyclopedia—will never know nor thank you for making the article complete, comprehensive and readable.

Example—Above you have a hint of the work and reward attached to a particular publishing venture. Now let's see how good a job the editors did on the fifth Interscience volume —Di- to Explosives.

The first long entry is Dialysis—an important subject in the rayon and electrolytic copper industries. Dielectrics, next long one, could be called a "use" article—it stresses applications and uses as well as theory. Diffusion (57 pages) is probably the best single article in Vol 5. It covers theory and applications of the three methods of separation: mass, thermal and gaseous diffusion. These methods, which differ from distillation and absorption in that they use an irreversible flow of heat or material, are comparatively inefficient. They are used in isotope separation.

Distillation (by Scheibel), Drying (by Marshall) and Evaporation (by Badger) are in the volume. These unit operations are adequately handled. There are long articles on Driers and Metallic Soaps, Dry Cleaning, Drying Agents, and Drying Oils. The Dust item covers two aspects: engineering and industrial hygiene. The dust removal problem is treated elsewhere—in Electrostatic Precipitation, for example.

The articles on Dyes (128 pages) are important. They bring together a lot of material that's difficult to find. They cover nomenclature, history, economics, classification, application, evaluation.

The "E's" begin with Economics, Chemical—a 19-page review by Chaplin Tyler. The editors then skip all references, cross or otherwise, to eddy currents, edinol, effervescence, efficiency, and efflorescence. Eggs come next, 13 pages by Alexis Romanoff who is an authority and author of the recent "The Avian Egg." The editors immediately return to subjects of greater interest to chemical engineers: Electric Instruments, Electroanalysis. Electrochemistry (54 pages by Akerlof) is a good solid review of theory. It supplements nicely the 36 pages (by Faust and Safranek) on Electroplating. The couple of pages on Electrodecantation are interesting. Electrosynthesis tells some of the trick things that have been and can be done in a comparatively new field. A short interesting article is Embalming Fluids. Surprisingly enough, this is the only place where the editors allowed an author to editorialize.

Other long articles expound on Emulsions, Enamels, Enzymes, Equilibrium, Esterification and the book

(Continued)

YOU DON'T SAY!

—*Oddentities from Vol. V, "Encyclopedia of Chemical Technology"*

In 1948, $37½ million was spent for dry cleaning solvents, soaps and chemicals.
No definition for dust has been completely satisfactory.
In the U. S. today more than 1,000 individual dyes are produced.
Wool as it comes from the sheep contains 30-80% impurities.
To spend money for research is no guarantee of success.
With age, eggs may change in odor and flavor.
More than 600 atomic species are known for less than 100 elements.
France prohibited the use of arsenic in embalming fluids in 1846.
Emulsion technology is based on trial-and-error experience.
Almost all inorganic compounds are potential ingredients for enamels.
Young rats are not as prone to diuresis as older ones.
Most commercial ether is a byproduct of alcohol production from ethylene.
Under certain circumstances, manufacture of ethylene from ether is economical.

winds up with Explosions. (Continuing the pyrotechnics, Vol. 6 will start with Explosives.)

You and I now know how to compile an encyclopedia. As experts we can appreciate the work that went into the Interscience volume under discussion. As users of this chemical reference book (and its mates) we can appreciate the editors' efforts toward completeness, comprehensiveness and readability.—*LBP*

Abstract Theory

PHYSICAL CHEMISTRY OF THE HYDROCARBONS, VOL. I. Edited by A. Farkas. Academic Press, Inc., New York. 453 pages. $8.50.

Reviewed by Gustav Egloff

"Physical Chemistry of the Hydrocarbons," Vol. I, covers nine fields, written by the following experts: G. W. Wheland, M. H. Jellinek, J. J. Mitchell, Norman D. Coggeshall, Andrew Gemant, Alfred W. Francis, M. R. Cines, and Frederick D. Rossini.

Specialists of the Universal Oil Products Co., Donald Long, D. L. Holden, J. B. Grutka, A. J. De Rosset, and C. H. Watkins, have reviewed sections of the book. They comment as follows:

With the exception of the sections on applied mass and optical spectroscopy, this book has emphasized abstract theory too greatly. This is particularly true since the theory appears often to be presented for its own sake, little attempt being made to derive mathematical relations in a form convenient for use.

The chapter on the chemical bond contains a rather interesting qualitative discussion of valence theory, bond angles, bond types, strain theory and resonance. A few applications to hydrocarbon chemistry are given.

However, roughly half of the chemi-

(*Continued*)

RECENT BOOKS RECEIVED

Advances in Colloid Science. By H. Mark & E. J. W. Verwey. Interscience. $7.50.

The Alkaloids—Chemistry and Physiology. Vol. I. By R. H. F. Manske & H. L. Holmes. Academic Press. $10.

Analytical Absorption Spectroscopy. By M. G. Mellon. Wiley. $9.

Introduction to the Transfer of Heat and Mass. By E. R. G. Eckert. McGraw-Hill. $4.

Materials Engineering of Metal Products. By N. E. Woldman. Reinhold. $10.

Pocket Encyclopedia of Atomic Energy. By Frank Gaynor. Philosophical Library. $7.50.

Principles of Ionic Organic Reactions. By E. R. Alexander. Wiley. $5.50.

Properties of Metals at Elevated Temperatures. By G. V. Smith. McGraw-Hill. $7.

Safety in Factories. International Labour Office. $8.50.

cal bond chapter is devoted to mathematical formulas of quantum mechanics which will not be understood by anyone other than a fellow expert. This lengthy discussion hardly helps one appreciate the later results; for example, why the chosen set of "hybridized bond orbitals" on page 35 is "reasonable." It is also felt that the usefulness of the mesomeric concept of the English theorists (Ingold and others) is dismissed rather lightly.

The chapter on x-ray and electron diffraction contains so much theory that it largely overbalances the practical applications. For instance, the theory of x-ray diffraction by both gases and liquids is discussed at length, but hardly any results are given. A number of applications of x-ray patterns are omitted; for example, "fingerprinting" organic compounds, and determining their crystallite size, molecular weight or degree of orientation. The best section is that on x-ray diffraction by crystals. Two interesting tables summarizing important x-ray and electron diffraction results on hydrocarbons are given.

The chapter on mass spectroscopy is well presented and is much more practical than most other chapters. Certain information given is rather misleading, however. For example, with occasional sensitivity checks using a known gas, recalibrations do not have to be carried out weekly, but may even be reliable for six months. It is not necessary to remove carbon dioxide, since it can be determined directly. It is also misleading to indicate that "for hydrocarbons ranging up to C_6's, the mass spectrometer is an accurate and versatile analytical tool." While the technique is useful, the above statement certainly does not apply even to the C_6 olefins and naphthenes.

The chapter on the theory of optical spectroscopy is better than comparable sections of other chapters since a number of examples illustrating the theory are given, and one does not lose sight of the experimental side. The chapter on optical methods of analysis is well written. However, one gets the impression that gas analysis of hydrocarbons by infrared spectroscopy is a rapid and convenient technique. In practice, a mass spectrometer is almost always used because time consuming distillation is avoided and more components can be determined. It is also well to point out that the H-1 and H-2 lamps mentioned as suitable lamps for Raman spectroscopy are seldom used because of their high background intensity.

The treatment of the solvent extraction of hydrocarbons is primarily on the theoretical side also. However, many critical solution temperature data are given. These, together with references to the literature on specific ternary systems should prove useful.

Emphasis in the chapter on solid-liquid equilibria is on pure compounds, and no systems of present day technological importance are discussed. The author discusses the time-temperature and precision calorimeter techniques for determining freezing points and heats of fusion. He shows a decided bias for the latter method with which he was associated in 1947. The process of purification by crystallization is presently of limited application, but the extreme degree of purity cited by the author for certain separations indicates interesting future possibilities of commercial employment.

The theory in the chapter on thermodynamic equilibria is very well presented. There is an important typographical error in Eq. (3), p. 364, which should read $dE = \delta Q - d(PV)$. Unfortunately, there is little or no discussion of the significance of the various thermodynamic properties, or of how the data in the tables can be used. It has apparently been assumed that the scientists reading the book are already well acquainted

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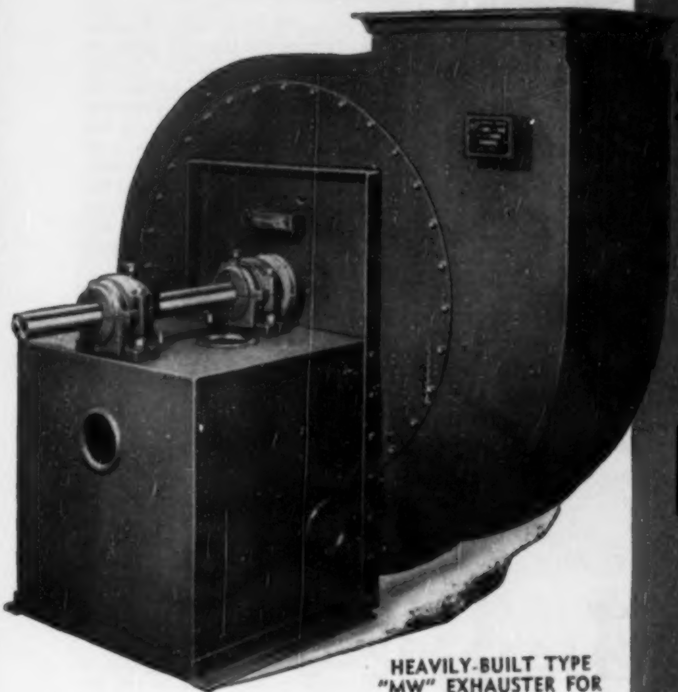

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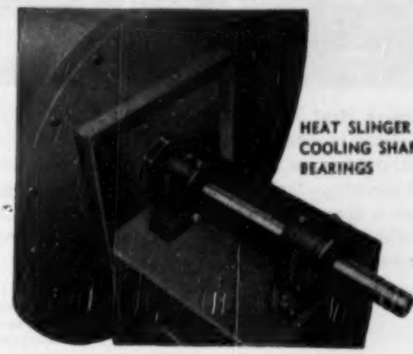

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with the utility of the data. Equilibrium diagrams are given for many reactions involving O_2, H_2, H_2O, C, CO, and CH_4. Other useful diagrams on the equilibria of the low molecular weight paraffins and olefins are given.

This book contains a few well-balanced chapters that would provide a good introductory orientation in the fields covered. The bibliographies at the end of each chapter are well chosen and would provide a good guide to further study.

10 + 2 = 12

TWELVE LECTURES ON THEORETICAL RHEOLOGY. By Marcus Reiner. Interscience Publishers, New York. 162 pages. $4.

Reviewed by George E. Alves

"Twelve Lectures" is the second book on rheology by the author to be published recently. This book is an enlargement and revision of the author's "Ten Lectures" published in 1943.

The initial lectures are devoted to definitions, use of tensors, classical bodies, and application of Mohr-circle to represent the stress tensor.

Dimensional analysis and rheological similarity are treated in one lecture. Another deals with rheological models. These are made up of three basic mechanical elements—the spring to represent elasticity, the dashpot to represent viscosity, and the movable weight on a surface with sliding friction between both to represent yield stress.

Simple pull of a rod, simple bending of a beam, strength, rupture, and equations of Navier-Stokes and Hagen-Poiseville are discussed in other lectures.

Later lectures are devoted to topics such as creep, Bingham body, the flow of a Bingham body in a tube and the corresponding behavior in a concentric cylinder viscometer, and generalized and special bodies.

Amplifying notes are at the end of each lecture. A systematic notation is used and is well explained at the beginning of the book. Included is a large bibliography. In the index the appropriate symbol is given after all quantities. Having quoted in his recent book "Deformation and Flow" page references to the "Ten Lectures," a table is appended giving the page numbers in the present book corresponding to those in "Ten Lectures." (For a review of "Deformation and Flow" see "Chemical Engineering," June 1950.)

In general, the book is a more

(Continued)

mathematical exposition of portions of the material presented in "Deformation and Flow." This book is written in a clear informal style; however, a fair knowledge of mathematics would be helpful to the reader.

"Twelve Lectures" can be recommended to chemical engineers interested in the theoretical aspects of rheology.

Hopeful Tone

COAL, COKE, AND COAL CHEMICALS. By Philip J. Wilson, Jr. and Joseph H. Wells. McGraw-Hill Book Co., New York. 509 pages. $8.

Reviewed by Jerome J. Morgan

The authors are Former Senior Fellow and Senior Fellow respectively of the Carnegie-Illinois Steel Corp. Fellowship, Mellon Institute; and as such are unusually well fitted to write on the subject.

In the preface it is stated that the aim is to produce a book useful to businessmen and others outside the industry. Hence they start with a simplified yet accurate account of coal carbonization, its history, processes, products and trends. This is followed by classification of fuels with clear concise discussions of various fuels, and combustion explained in its simplest terms including chemical reactions, material and heat balances, and thermal chemical equations. Though simplified it would seem difficult for a layman to get much of a grasp of the large amount of material given.

The formation of coal, its elementary composition, classification, and petrographic constituents are well explained. The chemical constitution however would be hard reading for a layman, and the treatment is too brief to give much information.

The chapter on tests and factors in relation to characteristics of coal for carbonization; plasticity, bulk density, expansion and pressure, is well done; as is also that on crushing, screening, washing and storage of coal.

The construction and operation of coke ovens, including characteristics of refractories, have been made simple enough for the businessman, but contain a wealth of information for the fuel engineer. The discussion of the coking process in byproduct coking, its chemistry, products, plastic zone, temperature and pressure effects, heat requirements and balances, is very good, though on p. 172 aromatic structures with only three carbon valence bonds showing look queer.

The chapter on high temperature

(*Continued*)

coke, its chemical composition, physical properties and effects of coking conditions, contains an especially good section on utilization of this coke in blast furnaces, foundry cupolas, water gas sets, gas producers and as domestic fuel. Coke-oven gas; its collection and treatment in the plant plus conditioning to remove such impurities as, hydrogen sulphide, cyanides, naphthalene, nitrogen oxides and gum formers; its dehydration, storage and metering; is given a brief but clear and authoritative treatment.

Then follow three chapters in which brief but adequate discussion is given of ammonia and its salts including disposal of still wastes; light oils with some theory of scrubbing; and coal tar, its distillation and separation of the main products.

Under coal carbonization in gas manufacture horizontal and vertical retorts are described and compared in results with coke ovens. In another chapter the current low temperature carbonization plants, Disco, Krupp-Lurgi, and Hayes, together with a number of obsolete ones are described. In the same chapter is a good discussion of the Curran-Knowles sole flue oven.

In the two final chapters economics of coal carbonization, and its trends are discussed, with numerous tables giving data not usually available in a single place, and with a generally hopeful tone. In this discussion as well as throughout the book the authors are to be complimented for their use of factual data in tables and graphs to support statements in the text.

The text is well written, and should be on the reference shelf of anyone interested in fuels.

Substantial

REFRACTORIES. Third Edition. By F. H. Norton. McGraw-Hill Book Co., New York. 782 pages. $8.50.

Reviewed by G. J. Easter

Here's a substantial revision of a well known text. The former chapter on crystal chemistry has been omitted but directions are given for finding this type of material if desired. Several new chapters of timely interest have been added and practically all portions of the book rewritten and enlarged. Drawings and photographs are clearer than in the older editions. Several cost figures are still in prewar values but the statistics of the industry have been brought up-to-date (1946) in both dollars and tons. Unfortunately data on the important silicon carbide refractories industry are

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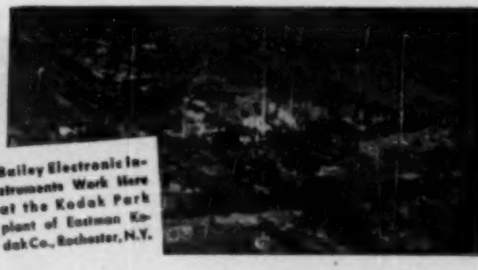

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omitted. Bibliographies have been expanded and are well tied in with the text by number.

In the rewritten chapter on molding methods, theories as to the mechanism of workability are discussed and applied, particularly to slip casting. The relatively new methods of forming by hydrostatic molding and by hot pressing are described though vibratory pressing is not.

A new chapter relates to laboratory furnaces. The treatment of high frequency induction furnaces for laboratory use is unusually complete, covering both equipment and operating techniques. Discussions of other furnaces, both lab and plant, have been revised. Air preheaters and rotary calciners are newly included as well as the more orthodox kiln types.

There is an excellent new chapter on the newer high purity refractories which have come to be of special interest in relation to recent wartime developments. Not only metals and their oxides but silicates, zirconates, carbides, nitrides, borides, etc. (even refractory sulphides) are evaluated. The combined metal plus nonmetal materials (cermets) are mentioned but not in detail. Growth of large synthetic single crystals is covered.

All the regular methods of testing refractories are quoted in detail from ASTM and other tests—such as those for creep of refractory materials—are described where these seem of importance. There is a short but helpful discussion of the application of test results in furnace design. The effects on refractories of gases other than CO are discussed. Warning is given that certain refractories react with one another when hot although the table of permissible safe temperatures is not convincing in this connection. Thermal expansion data and emissivity coefficients are shown for an unusually wide range of materials. The section on particle size measurement would be improved by inclusion of tolerance limits as well as the nominal openings of sifting screens.

The chapters on the use of refractories have been rewritten to bring them up to date with several new pictures particularly in the boiler furnace field. Two new chapters of particular note relate to the as yet small volume application of refractories in nuclear power production and in gas turbines and jet propulsion. The first discusses clearly the principles involved in nuclear fission and the accompanying requirements of refractories for specific parts of prospective reactors. The second constitutes an unusually complete treatise on jet engines and

(Continued)

rockets with discussion of the temperatures, fuels and mechanical requirements in this still largely undeveloped field.

In general, the index could be expanded to advantage. The book is readable and authoritative and warrants purchase by the worker in refractories even though he may already have an earlier edition.

Reasonable Success

AGRICULTURAL CHEMISTRY. Vol. I. (Principles of Agricultural Chemistry.) Edited by Donald E. H. Frear. D. Van Nostrand Co., New York. 812 pages. $9.

Reviewed by W. B. Van Arsdel

In his preface to this first volume of a projected two-volume work, Dr. Frear, Professor of Agricultural and Biological Chemistry at Pennsylvania State College, says that his intention has been to collect an authoritative general reference text, written by men who are recognized specialists in their fields. The work is aimed at "serious students of the subject"—graduate level students, specialists engaged in agricultural work, such as county agents, extension workers, and technical employees of firms dealing in agricultural chemicals, and, finally, research investigators who need information in fields bordering their own. The second volume is to be devoted to practical applications of the principles of agricultural chemistry.

The reviewer feels that Professor Frear has been reasonably successful in his ambitious and difficult undertaking. The volume under review will, indeed, be a valuable reference text for many persons in the categories he has named. As might have been expected, the authors have not all interpreted the purpose of the work in the same way; the result is a wide variability between chapters in the degree of specialization presupposed in the reader. A few, for example the chapters on utilization of carbohydrates and nitrogen compounds in plants, will be found difficult by specialists in closely related fields. A few others, such as the chapter on energy metabolism in animals, can be understood at the senior undergraduate level. Most of the chapters are written with the reference purpose foremost. More than 1,800 references to texts or research papers are cited in the bibliographies, one of which follows each chapter.

The volume is organized into five parts: Some fundamental materials and processes common to plants and

(*Continued*)

animals; chemical processes of fundamental importance in agriculture; plant chemistry; animal chemistry; and soil chemistry. Some overlapping and duplication occurs, as was inevitable. The mechanism of carbohydrate metabolism is discussed, for example, in three of the chapters, although from somewhat different viewpoints. On the other hand, the boundaries of the domain of agricultural chemistry are never very rigidly defined. At one extreme is a discussion of the biophysics of cell growth; at the other, a distinctly practical review of some problems in animal husbandry. The reviewer feels that Professor Frear was wise not to insist on too rigid a definition. Relationships across boundaries are too often ignored by the specialists on both sides. While many of these chapters are beautifully lucid, some of the authors have not had the forbearance to write for the miscellaneous audience defined in the preface, but have essentially written review articles for scientists within their own clans.

On the whole, the work is an excellent summary of the state of knowledge in its field as of late 1948. A few references to 1949 publications appear in the text. The standard of typography and editorial vigilance is uniformly high.

Reference

LANGE'S HANDBOOK OF CHEMISTRY. Seventh edition. By Norbert A. Lange. Handbook Publishers, Inc., Sandusky, Ohio. 1934 pages. $7.

Here is the mixture as before, judiciously laced with revisions, extensions and additions. Speaking broadly, the book again gives vital statistics, in tabular form, on the elements, inorganic and organic compounds, analytical and physical chemistry, and industrial chemistry. Into the last category fall materials of construction, alloys, ceramics, wood, wire tables, sieves and screens, hazardous chemicals, humidity tables, tank capacities, densities of solutions, industrial water, fuels, manufactured and natural gases, steam tables, cooling baths.

The table of isotopes, for one, has had a complete overhauling. The periodic chart, description of the elements, plastics and synthetic rubbers, composition and use of foods, corrosion and heat resistant alloys are among those tables substantially changed to keep up with current developments.

New features include tables on glyceride content of drying oils, prop-

(Continued)

erties of hormones, ASTM classification of coals by rank, dielectric constants, dipole moments and logarithms of equilibrium constants. To make room for these without greatly upping the size and price of the book, the compiler has left out some of the mathematical data which appeared as an appendix in the previous editions. —*FA*

Not Above Reproach

Data Book on Hydrocarbons. By J. B. Maxwell. D. Van Nostrand Co., New York. 259 pages. $5.

Reviewed by W. H. B. Geoghegan

The preface to this book states that its "primary purpose . . . is to provide (1) basic data on hydrocarbons and petroleum fractions, (2) methods of applying these data to process engineering, including illustrative examples and some fundamental theory, and (3) applications of a few of the unit operations of chemical engineering used extensively in the petroleum industry."

The scope of this volume may be shown by an enumeration of its fourteen major sections: physical constants, characteristics of petroleum fractions, molecular weight, vapor pressure, fugacity, critical properties, thermal properties, density, viscosity, combustion, flow of fluids, flow of heat, equilibrium flash vaporization, fractionating towers. Included at the end are a table of conversion factors and an index.

Taking the book as a whole, it may be said that the author has achieved his stated purpose. Data in the various sections are presented chiefly in the form of graphs, and as a result a very large amount of information has been packed into the book's 259 pages. In each section the actual presentation of data is preceded by a short discussion explaining the use of the charts, and including a list of references. The author has been quite scrupulous in defining the limits and conditions within which the data may be applied, and, where necessary, in outlining the background of his correlation methods. This feature is very valuable in a presentation of this type, in which a considerable portion of the information has been arranged by empirical or semi-empirical methods, and may not necessarily be extrapolated freely.

As a practical collection of engineering data on hydrocarbons, the book is unequalled in scope by anything previously seen by this reviewer. It is strictly an engineering work. The

(*Continued*)

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charts, all quite legible, are constructed to be read with accuracy to match slide rule calculations, and where precise and necessary data are lacking, various empirical devices have been employed to supply them.

One feature not to the liking of the reviewer is the almost uniform use of atmospheres as the unit of pressure. While this no doubt has a certain simplicity in some thermodynamic usages, it is not an engineering unit generally employed, and the use of the charts plotted in atmospheres requires either a considerable amount of conversion of units, or else the adoption of calculation methods to fit this particular book.

Sections 11, 12, and 14 are considerably less impressive than the rest of the volume. The subject matter in them has been much compressed, and although many routine problems might be solved, or approximately solved, by their use, they do not constitute a reference section suitable for extensive design work. Radiant heat transfer, for example, is sketchily covered by one graph of black body radiation as a function of temperature up to 700 deg. F., accompanied by an emissivity table. The section on fractionating towers is a highly condensed treatment almost in the nature of a "refresher." The practical and essential step of translating theoretical steps into actual fractionating plates is covered only by Gunness' data of 1936, and no mention is made of more recent work which has shed additional light on this difficult problem, such as that of Drickamer and Bradford and of O'Connell.

Physically the book is well arranged and legible. The index is straightforward and reasonably complete. The checking seems to have been well done, as typographical errors are few.

The verdict: a book which will be extremely useful to any engineer whose work deals with hydrocarbons, and which, though not above all criticism, represents a good practical realization of the author's purpose.

Opinions

THE CEMISTRY OF INDUSTRIAL TOXICOLOGY. By Hervey B. Elkins. John Wiley & Sons, New York. 406 pages. $5.00.

Reviewed by H. H. Fawcett

Entirely different in its approach from the several other excellent books which have appeared on industrial toxicology in the past few years, this

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work is a valuable addition to the literature. Elkins is chief of laboratory, division of occupational hygiene, Massachusetts Department of Labor and Industries; chairman, committee on standard methods, American Conference of Governmental Industrial Hygienists, and member at large, Z-37 section committee on maximum allowable concentrations of toxic dusts and gases, American Standards Association. These contacts have given him a wealth of data, as well as strong opinions on the toxic effects of many chemicals.

The five major divisions of the book are: (1) brief discussions of elements, compounds and mixtures as to the nature and degree of their hazard without going into the details so characteristic of other books (153 pages); (2) preventive measures and review of industrial processes which create health hazards (32 pages); (3) detailed discussion of maximum allowable concentrations, in which the author describes why he feels his values are more nearly accurate than other quoted figures, (31 pages); (4) analytical methods and sampling procedures for commonly encountered hazards, based largely on the Massachusetts Division of Occupational Hygiene methods (128 pages), and (5) a bibliography with 366 references, followed by an index of 12 pages.

All through the book, the author's opinions and feelings are plainly stated. Also, the general concept of writing for chemists, chemical engineers, and plant supervision is carefully followed. Without question, the author has rendered a valuable service to industry, and the book is recommended without qualification. It is a very valuable "handbook" to the art and science of industrial hygiene, and should find a place in every industrial plant and technical school library.

93, 94, 95 and 96

THE TRANSURANIUM ELEMENTS, Parts 1 and 2. Edited by Glenn T. Seaborg, Joseph J. Katz, and Winston M. Manning. McGraw-Hill Book Co., New York. 1,733 pages. $15 for both parts.

Reviewed by J. Malcolm Miller

The two books to be reviewed here are a part of the National Nuclear Energy Series. This series is expected to be composed of approximately sixty volumes that will contain reports and reviews describing declassified research performed under the auspices of the Manhattan Project and the Atomic Energy Commission. "The Trans-

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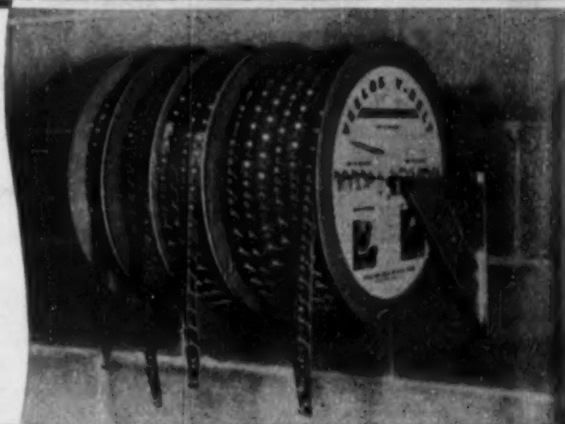

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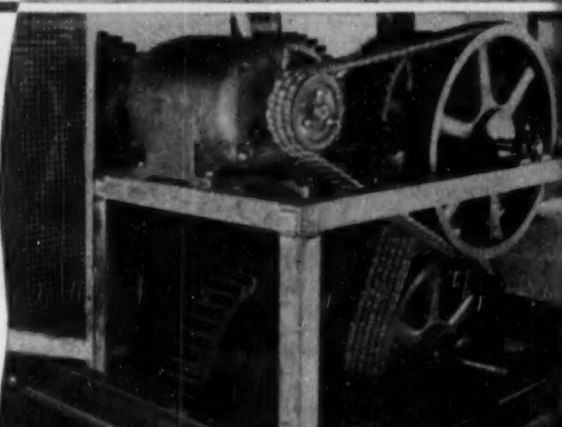

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uranium Elements," parts 1 and 2, are volume 14-B of Division IV (Plutonium Project) of the eight divisions into which the National Nuclear Energy Series is to be grouped. The volumes of division IV are apparently to consist of "A" and "B" volumes; the former to be be of a general survey and review nature, while the latter will contain the many reports that serve to document the "A" volumes.

"The Transuranium Elements," in 162 papers, describes part of the research of some one hundred and ten investigators at the Department of Chemistry and the Radiation Laboratory of the University of California, Chemistry and Physics Divisions of the Metallurgical Laboratory of the University of Chicago (now the Argonne National Laboratory), Department of Chemistry and the Institute of Atomic Research of Iowa State College, Clinton Laboratories (now the Oak Ridge National Laboratories), and the Department of Physics of Washington University at St. Louis.

The majority of the papers pertain to the discovery, isolation, and chemical and physical characterization of the element 94, plutonium, and its compounds. There are also a few papers on the investigation of the nuclear characteristics of plutonium isotopes. Approximately twenty reports are devoted to these same aspects of element 93, neptunium. The investigations of neptunium reported here, however, were carried out when the pressure on the various laboratories had apparently lessened somewhat and hence this relatively small number of papers nevertheless describes the results of a well-planned program to unravel the chemistry of neptunium and leaves the basic chemistry of this element in somewhat better condition than that of several of the more common elements. Approximately ten papers are concerned with the discovery, tracer chemistry, and preparation and investigation of microgram quantities of americium and curium. There are also about ten papers on instrumentation and techniques, most of which are instructive and pertinent.

Since this volume is intended primarily to be a documentation of survey volumes, it contains no critical reviews of the great mass of data presented. It is unfortunate that probably for the same reason there is no subject index. There are, however, several author lists, one of which includes recent addresses.

With very few exceptions, each of the papers in this volume is of a caliber requisite to publication in an appropriate journal of the open literature

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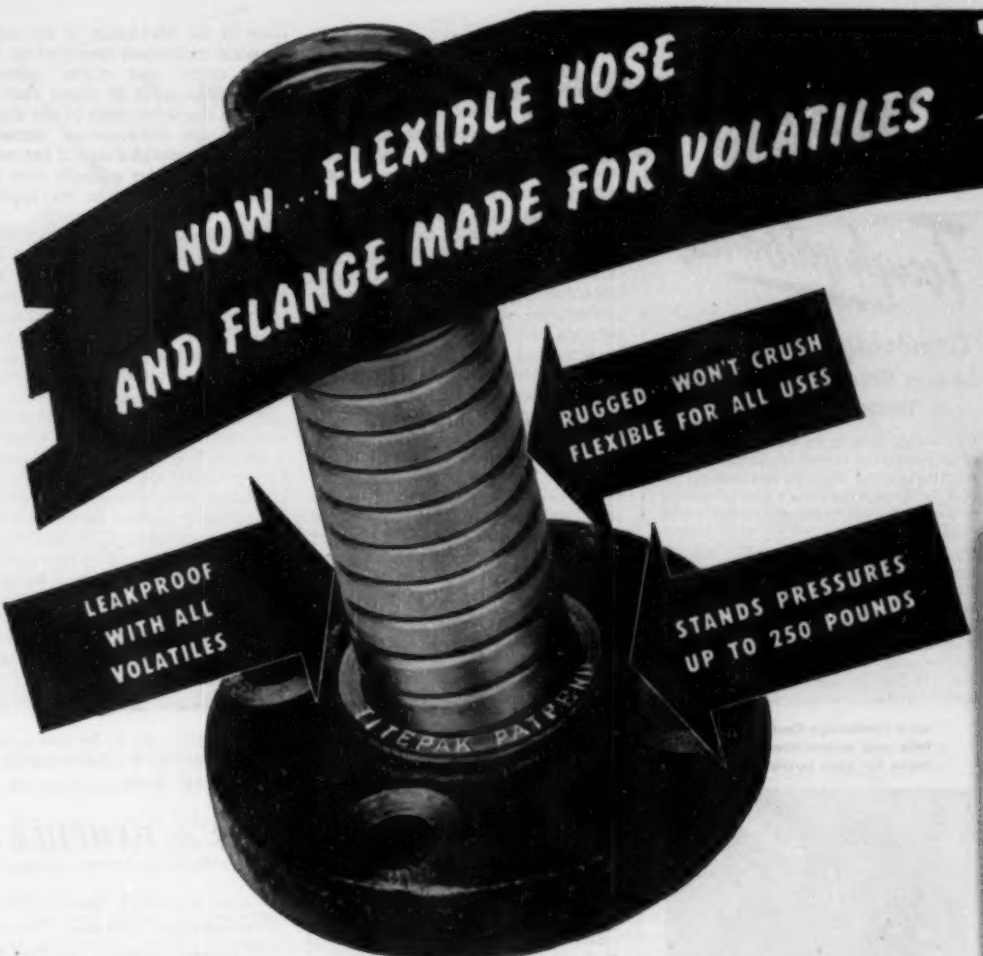

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both with respect to scientific content and method of presentation, although some of the articles at this time are primarily of historical interest and the results presented have since been superseded by more recent and complete investigations. To the best of the reviewer's knowledge in all such cases the more reliable data have been carefully indicated. By the inclusion of superseded data, however, this collection of papers achieves a coherent presentation of the growth of information on the transuranium elements from most of the first experiments indicating their existence, through the tracer studies on the micro-microgram level, through the impressive investigations with microgram quantities, up to the experiments with macro amounts. It is partially this attribute of the collection of papers that makes it of significance to others besides the specialist in radiochemistry. Indeed from a purely pedagogical standpoint, we have here in one collection a fairly complete description of both the classical and modern methods for studying the inorganic and physical chemistry of an element and its compounds.

"The Transuranium Elements" is of great value to the radiochemist not only because of its description of the inorganic and physical chemistry of these artificial elements, but also because of the description of the radiochemical techniques employed on the trace, micro, and macro quantity levels. The series of papers that report the characterization of the chemistry of the transuranium elements when only concentrations of the order of 10^{-14} molar were available is an important contribution to the application of "trace level" chemistry.

The techniques and the results described for the investigation of the solution chemistry of plutonium, and in particular of the equilibrium among the ionic species present in solutions, should serve both as a guide and a stimulus to the gathering of similar data for many of the more common but neglected elements.

These papers are no doubt only a small part of the large number of reports on the transuranium elements written under the Manhattan Project or the Atomic Energy Commission. This is made evident by the fact that many reports referred to in this collection are designated by that mixture of letters and numbers that represent volumes not often found in a library outside the government archives. The impression is gained, nevertheless, that here we have at least the more pertinent and representative of the declassified documents on this subject.

The editors are to be commended and thanked for a difficult but necessary task well done.

RECENT BOOKS & PAMPHLETS

Reports. "Bibliography of Technical Reports." Reports from civil and military agencies of the United States and from cooperating foreign governments are listed in a monthly booklet for the benefit of science and industry. Contains sections on chemicals and allied products, electrical equipment, food and kindred products, fuels and lubricants. $5 per year. U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C.

Engineers. "Engineers Offer New Frontiers." Need for engineers in positions, especially in small businesses, where they are not commonly employed. 8 pages. American Society for Engineering Education, Division of Relations with Industry, c/o A. B. Brownwell, Northwestern University, Evanston, Ill.

Fire. "Organizing Your Plant for Fire Safety." How fires start and how to prevent them, why automatic sprinklers are needed and how to maintain them, types of extinguishers and extinguishing systems. 91 pages. $2. Factory Mutual Engineering Division, 184 High St., Boston 10, Mass.

Steam Hook-Ups. When and where steam traps or temperature control should be used, what types to select, how correctly to size and install them. Hook-ups and equipment are illustrated. 64 pages. Gratis. 6th edition, Sarco Co., Empire State Bldg., New York 1, N. Y.

Mechanical Engineering. "Kent's Mechanical Engineers' Handbook." Two volumes. One on "Design and Production" covers selection of materials, design principles, design and selection of machine components, production processes, production plant equipment. Includes working formulas, charts and tables; standard dimensions, proportions, specifications; illustrations of typical equipment. By Colin Carmichael. 1660 pages. The other volume on "Power" is made up of sections on basic ingredients (air, fuel, heat, steam); service functions, pumping and piping; equipment (boilers, turbines, condensers, gas turbines); refrigeration, heating, ventilating and air conditioning; diesel engines, land, air and marine transportation; electric power; atomic energy, instrumentation, power test codes. By J. Kenneth Salisbury. 1460 pages. $8.50 each. 12th edition, John Wiley & Sons, 440 Fourth Ave., New York.

Business Cycles. "Statistical Indicators of Cyclical Revivals and Recessions." Study of the period up to 1938. By G. H. Moore. 95 pages. $1.50. Occasional Paper 31, National Bureau of Economic Research, 1819 Broadway, New York 23, N. Y.

Air Pollution. "Industrial Wastes, 14th Annual Meeting." Eleven papers cover the chemical, engineering, meteorological, legal and health aspects of the subject. 116 pages. $2. Transactions Bulletin No. 13, Industrial Hygiene Foundation, Mellon Institute, 4400 Fifth Ave., Pittsburgh 13, Pa.

Water Pollution. "Guide to Source Material on Water Pollution Control, May 1950." 30 pages. Gratis. Federal Security Agency, Public Health Service, Division of Water Pollution Control, Washington 25, D. C.

Methyl Ethyl Ketone. Commercial applications with emphasis on surface coatings. Other applications discussed include adhesives, cleaning compounds, dyes and insecticides, use in mineral oil refining

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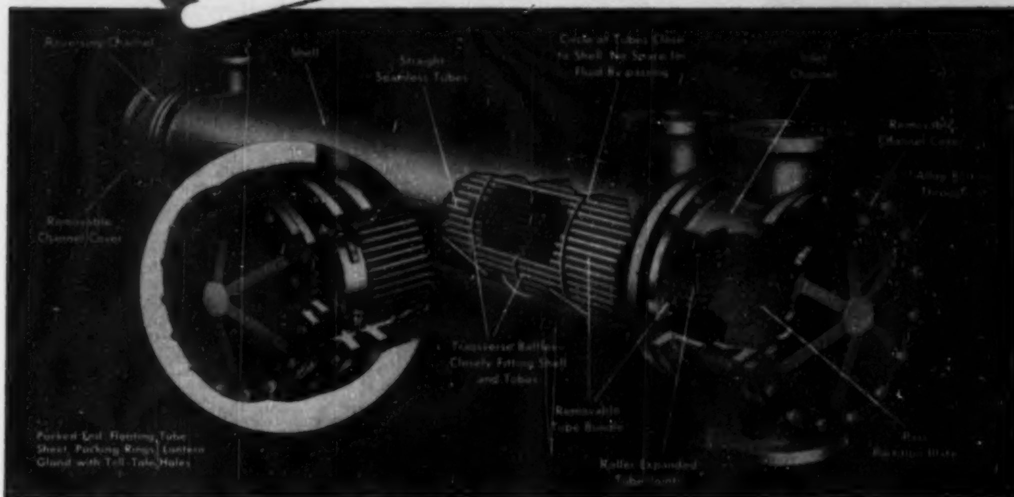

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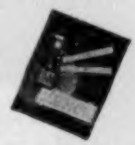

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and solvent extraction. 130 pages. 2nd edition. Shell Chemical Corp., 50 West 50th St., New York 20, N. Y.

Labor. "New York State Disability Benefits Law." Text of law, outline of major provisions, topical index. 55 pages. New York State Workmen's Compensation Board, State Office Bldg., Albany, N. Y.

Pacific Northwest. "Major Industrial Potential of Snohomish County, Wash." Survey of raw materials, water and power supply, port and transportation facilities, climate and population. Maps, tables, photographs. Outlines some specific areas of possible industrial development. By Ivan Bloch. 136 pages. Snohomish County Public Utility District, 2030 Colby Ave., Everett, Wash.

Coal. "Hydrogenation Studies on Midlothian Coal." By Fred W. Bull. 12 pages. 20 cents. Engineering Experiment Station Series No. 74, Virginia Polytechnic Institute, Blacksburg, Va.

Society Journal. "Journal of the Imperial College Chemical Engineering Society, 1948." Twelve papers cover such subjects as liquid-liquid extraction, valves for process plant, mixing, design of gas lift pumps. 207 pages. Imperial College Chemical Engineering Society, Chemical Technology Bldg., Prince Consort Rd., London, S.W.7, England.

Research. "Management of Industrial Research." An annotated bibliography prepared from the viewpoint of the research director. 14 pages. Gratis. Arthur D. Little, Inc., Memorial Dr. at Kendall Sq., Cambridge 42, Mass.

Research. Picture presentation of the facilities for research at Georgia Tech in such fields as chemical, mechanical and biological engineering and physical and organic chemistry. 36 pages. Gratis. Georgia Institute of Technology, State Engineering Experiment Sta., Atlanta, Ga.

Mobilization. "Industrial Mobilization Program." A new manual to guide the military departments, other government agencies and industry in coordinated planning for the production of materials which would be needed for war. 75 cents. Munitions Board, Manual No. 40-1, Superintendent of Documents, Washington 25, D. C.

Coal Hydrogenation. "Hydrogenation of Petroleum and Lignite Tar Distillates." A report of the laboratory investigation in the vapor-phase section the Coal Hydrogenation Demonstration Plant at Louisiana, Mo. Mimeographed. By E. A. Clarke. Bureau of Mines, R.I. 4676, Superintendent of Documents, Washington 25, D. C.

Explosions. "Report of Research and Technologic Work on Explosives, Explosions, and Flames Fiscal Year 1949." A summary of the experimental results and some indication of continuing programs now in progress. Mimeographed. By Bernard Lewis. Bureau of Mines, R.I. 4667, Superintendent of Documents, Washington 25, D. C.

Handbook on Aerosols. Chapters from the Summary Technical Report of Division 10, National Defense Research Committee. 60 cents. Atomic Energy Commission, unnumbered document, Superintendent of Documents, Washington 25, D. C.

Trade. "Operation of the Trade Agreements Program." Present status of trade agreement negotiations and plans for tariff adjustment. 25 cents. U. S. Tariff Commission, Report No. 163, Second Series, Superintendent of Documents, Washington 25, D. C.

Nickel Alloys. Compilation of present knowledge with literature references. 50 cents. National Bureau of Standards, C485, Superintendent of Documents, Washington 25, D. C.

Compressed Air Power Basic reference data on compressed air and gas power. Three sections cover uses, theory and types of compressors. Illustrated. 18 pages. Compressed Air and Gas Institute, Committee on Engineering Education, 1410 Terminal Tower, Cleveland, Ohio.

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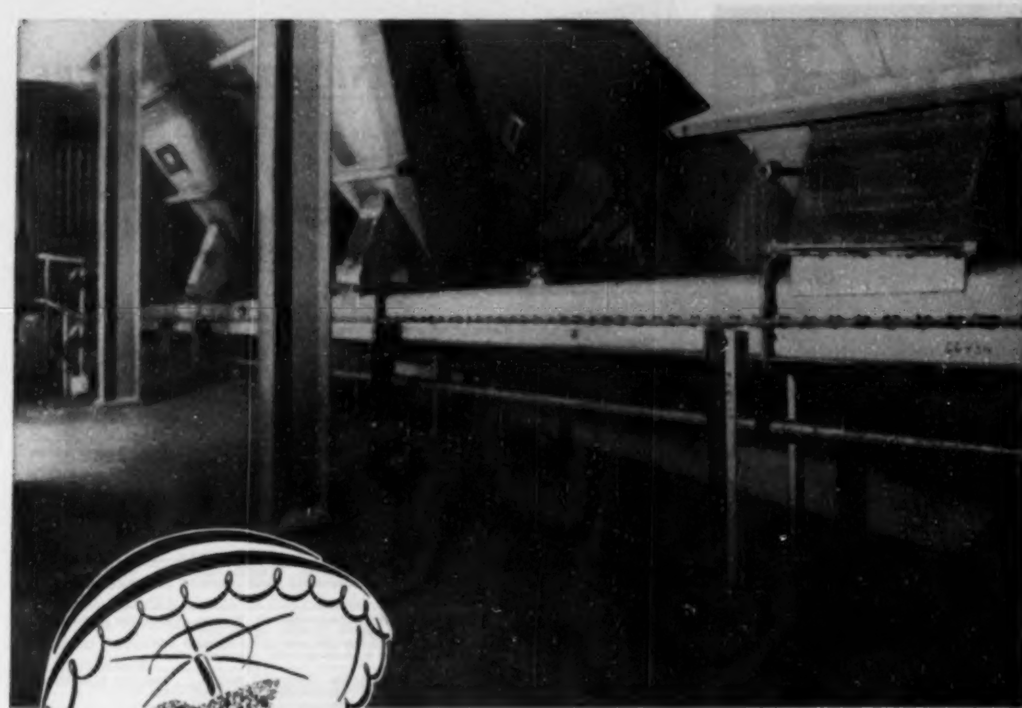

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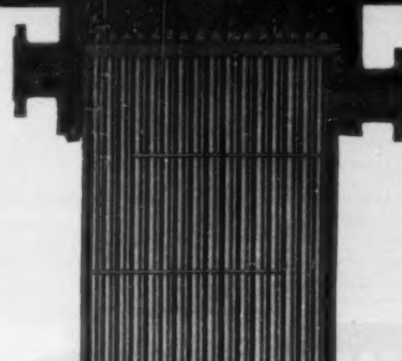

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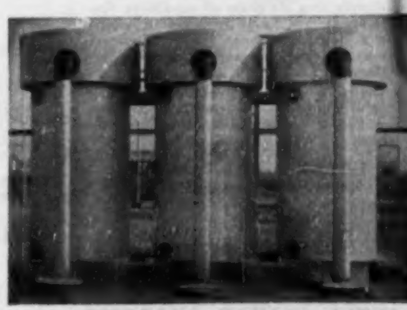

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Chemical Economics

RICHARD F. WARREN, *Market Editor*

Heavy Demand Keeps Chemical Consumption High in Most Consuming Industries

Chemical consumption—along with general business—seems to be running well ahead of even the most optimistic forecasts. March consumption of industrial chemicals reached an all-time high. *Chemical Engineering's* Index of chemical consumption soared to 255—this was more than 12 points above the previous high reached in 1948. In April the index stood at 248.—Preliminary data for May and June point to a continued high operating level in those months.

The tremendous demand along with other inflationary influences has set off a chain reaction in many basic chemical prices. This reaction has been spreading as producers of intermediate chemicals felt the impact of rising costs and in turn increased prices. Among the chemical prices that rose during recent weeks are carbon tetrachloride, chlorobenzene, phenol, aniline, styrene, and ethyl alcohol, soda ash and chlorine. While solid caustic prices rose, the announced hike in Solvay's liquid caustic was annulled.

The boom has pushed demand ahead of production in the pulp and paper industry. As a result, pulp and paper prices have moved upward. Paper production in June was about 102 percent of rated capacity. Board operations were almost 95 percent of rated capacity.

Textiles have also responded to the rush of business and chemical use in textiles jumped forward again in May. It is running well ahead of the corresponding 1949 monthly rates. The jump in textile chemical operations is viewed with pleasure by the dye industry which had a real slump in 1949 compared with 1948 operations. Data released in June shows that sales last year dropped to 136 million pounds (production was 139 million pounds). Sales in 1948 reached 187 million pounds. The 1949 dip in output extended to all major chemical classes of dyes. Azo, anthraquinone vat, indigoid, and sulphur dyes followed the general trend.

Nevertheless, textile chemical producers are not riding on any gravy train. In testimony before the chemical panel of the Committee for Reciprocity Information, George W. Russell of the American Cyanamid Co. pointed out that proposed tariff cuts will make domestic production of potassium and sodium ferricyanide unprofitable. He blamed the competitive advantage of imported ferricyanides on (1) the 50 percent tariff reductions granted in 1948, (2) socialized production abroad and (3) low foreign labor costs. He stated the domestic producers needed a boost in tariffs rather than a reduction and recommended a return to the pre-1948 rate.

Tariff duties on chemicals have been the subject of considerable discussion in recent weeks. This is due to coming international trade negotiations. Many chemical executives have pointed out that devaluation of the foreign currencies has had a serious effect on our world trade in items such as chrome chemicals. Before the war we supplied Britain, Australia and India with chrome products, but we have lost 70 percent of our export trade on these items. Here, too, low labor costs and devalued currency have worked against domestic output.

Two sodium hydrosulphite producers were among the chemical firms arguing for the retention of the present tariffs on that chemical. They pointed out that British producers were receiving an indirect subsidy by government regulation. One producer claimed that his firm had lost all foreign markets for this chemical since the end of the war.

Steel industry has been doing its share in keeping the chemical business busy. For the past three months the consumption of chemicals in iron and steel has been running at a record level. Late in June the steel industry had turned out 19,230,000 tons in a ten week period. This is an all-time record. The present cycle of more than 100 percent operations started in April and has been maintained through June.

Other process industries adding impetus to current activities are fertilizers, paint and varnish, industrial explosives, petroleum and coal chemicals.

The current boom is not confined to the chemical consuming industries. According to a report from the National Association of Purchasing Agents, general business had reached a high point for the year at the end of June. Purchasing agents report that June held the advances made in May and business moved substantially higher in terms of production and new orders. Much of this increase was in anticipation of July's industrial vacation shut-downs. Inventories have continued to increase, however turnover is reported to be improving and is considered satisfactory. Some industries are finding production is unbalanced by slow delivery of hard-to-get materials. With employment at its highest point for the year, another encouraging note is sounded. Employee productivity is improving significantly.

General feeling is that business will hold at its present high levels throughout most of the third quarter. As the international situation remains tense, considerable activity on military items is coming. This too will push chemical consumption along at very high levels. Even without the war stimulant, however, it begins to look like 1950 will challenge the all-time 1948 records.

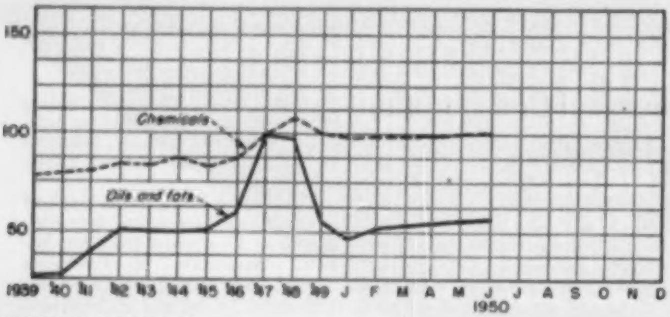
Price Trends

As mentioned earlier, the price trends for chemicals was upward again last month. *Chemical Engineering's* chemical price index rose to 102.31 by July 1. However, the fats & oils index dropped off during June. By the first of the month it was down to 54.45—a drop of two full points from the June 1 level. But some fats and oils ran counter to the trend.

With many prices showing an inflationary trend, buyers are taking as short a view of future coverage as is possible. Nevertheless, it is necessary to support production schedules and allow for increased procurement lead-time for many materials needed to keep plants humming.

PRICE, CONSUMPTION AND PRODUCTION TRENDS

PRICES

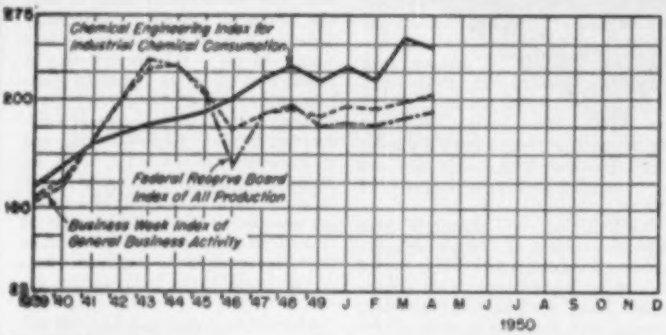


Chemical Engineering's Price Index a month, a year, and two years ago

	Chemicals	Oils & Fats
As of July 1	102.31	54.45
Last month	100.32	56.45
July 1949	100.48	52.74
July 1948	111.60	111.46

1947 = 100

CONSUMPTION



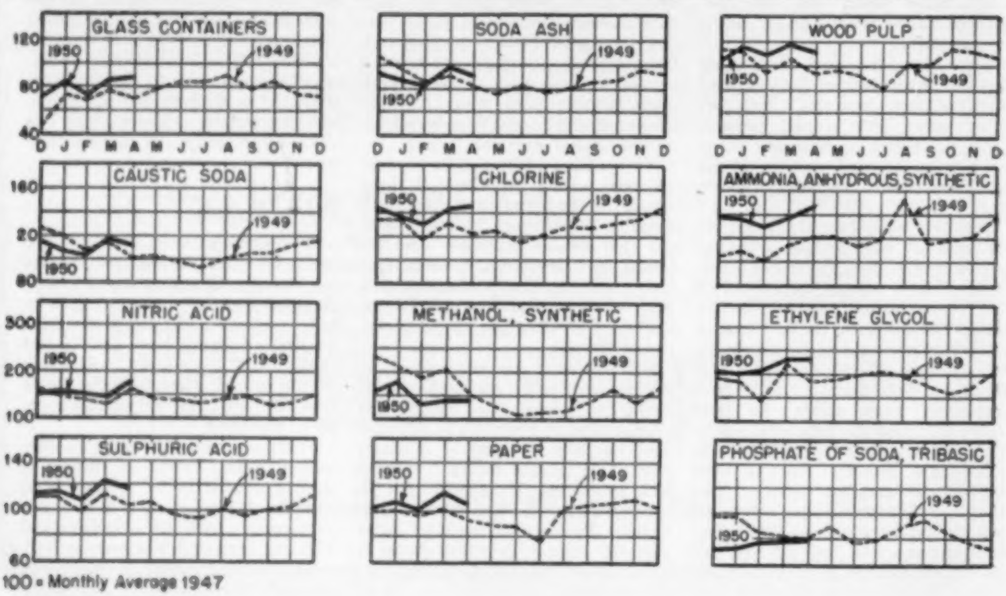
Chemical Engineering's Consumption Index for Industrial Chemicals

(A breakdown by consuming industries)

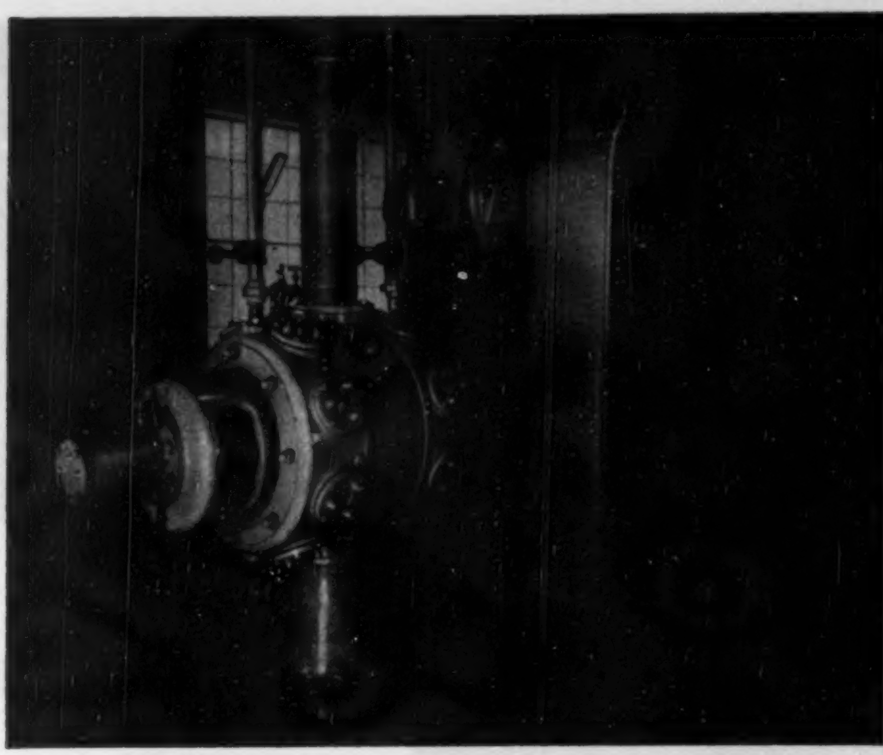
	March (Revised)	April
Fertilizers	64.40	62.25
Pulp and paper	26.55	24.83
Petroleum refining	21.60	20.25
Glass	19.21	19.76
Paint and varnish	24.20	24.28
Iron and steel	13.70	15.08
Rayon	29.76	27.70
Textiles	12.75	10.17
Coal products	9.19	10.61
Leather	5.00	4.37
Explosives	7.94	8.16
Rubber	5.73	5.55
Plastics	15.01	15.02
INDEX	255.04	248.03

1935 = 100

PRODUCTION



100 = Monthly Average 1947



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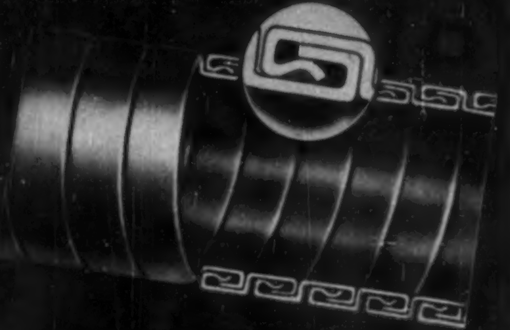

Top photo—CMH REX-TUBE Type RT-15 being used to steam out a storage tank. Middle photo—CMH REX-TUBE Type RT-15 used as a gas connection for a furnace. Bottom photo—CMH REX-TUBE Type RT-15 used for unloading a tank car.

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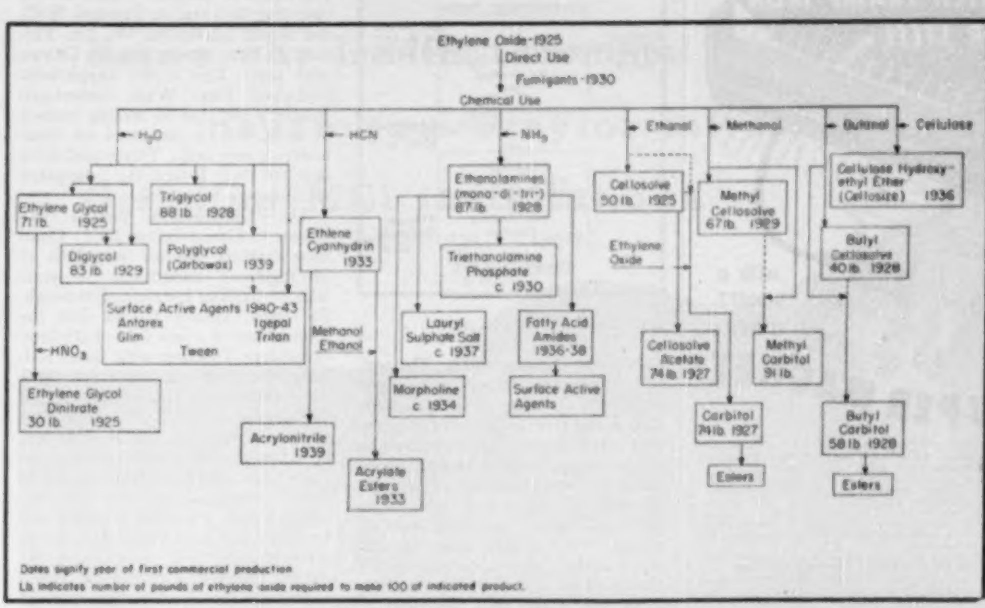

Two major processes made this pattern possible. This year more than 400 million pounds will pass through these channels.

Commodity Surveys:

ETHYLENE OXIDE

Basic raw material of many organic chemicals, its output doubled in the past two years. More is coming.

JOHN R. SKEEN, *Director of Market Research, Foster D. Snell, Inc., New York, N. Y.*

Ethylene oxide is an unusual chemical. Production capacity more than doubled within the last two years and probably will soon become 600 million pounds. The chemical is characterized by one dominant outlet—about 60 percent contributes to the antifreeze market. While there will be six producers in the near future, present stature—almost that of a heavy chemical—is attributable to the pioneering of a single company, Carbide and Carbon Chemicals Corp.

Ethylene oxide is highly reactive. The glycol series is obtained upon combining with water. With alcohols, the important glycol ethers and esters result. The ethanolamines and ethylene cyanhydrin derive from the addition of ammonia and hydrocyanic acid. From these four generic reactions come a long list of chemicals with many uses: anti-freeze, textile fibers and finishes, explosives, Buna-N rubber, surface active agents, solvents, plasticizers, hydraulic fluids, dyes, tobacco, cellophane, corrosion inhibitors, and others. The glycols are of greatest importance. They represent nearly 80 percent of the oxide and have the widest industrial distribution.

Until last year there was insufficient oxide to supply the demand. While this affected most industries, the situation was especially evident in the amount available for glycol anti-freeze. Normally this share is about 60 percent of the total oxide equivalent made. It was reduced to 40 percent and, so far as the civilian supply was concerned, less during early war years. Recovery has been slow.

Ethylene Oxide Producers

	Operating Dates	Process
Carbide & Carbon Chemicals Corp.		
South Charleston, W. Va.	1925	Chlorination (1925) Oxidation (1937)
Texas City, Tex.	1941	Oxidation
Whiting, Ind.	1951	Oxidation
Chicago Corp.[1]		
Corpus Christi, Tex.	1951	Oxidation
Dow Chemical Co.		
Midland, Mich.	1939[2]	Chlorination
Freeport, Tex.	1941[3]	Chlorination
Jefferson Chemical Co.		
Port Neches, Tex.	1948	Chlorination
Mathieson Hydrocarbon Chemical Co.		
Brandenburg, Ky.	1951	Chlorination
Wyandotte Chemicals Corp.		
Wyandotte, Mich.[4]	1948	Chlorination

[1]A combination of Chicago Corp., Pontiac Refining Co., Carthage Hydrocol and two others. [2]Periodic production. [3]Late 1941 or early 1942. [4]Production in the ratio of two parts ethylene oxide and one part propylene oxide.

There are several reasons for this, closely related to production requirements. Until 1937 ethylene oxide was made commercially only by reacting hypochlorous acid with ethylene. The resulting chlorohydrin is neutralized by milk of lime and the oxide recovered by successive fractionations. This procedure offers several advantages: the high-purity product may readily be converted into many derivatives, equipment costs are relatively low, and the process is efficient. A practice common to later producers is to convert the chlorohydrin immediately to ethylene glycol and co-products without isolating the oxide. The second process, operated first in 1937, consists in reacting a large excess of air with ethylene by means of a variously activated silver catalyst. Again, the product may be recovered as oxide or glycols. The catalyst is inexpensive and saves nearly all of the chlorine charges. However, the conversion of ethylene is around 50 percent and equipment costs have become high in comparison with the other method.

For many years, production was

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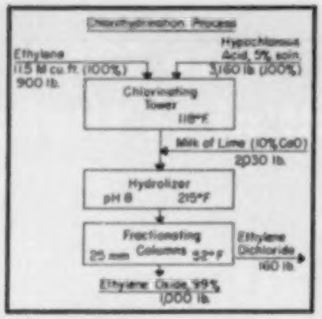

COMMODITY SURVEY, cont. . .

based upon chlorine alone. The periodic inadequate supply often prevented full operation of oxide capacity even in the 1930's. In part to circumvent this handicap, an oxidation unit was put in operation at South Charleston. With the coming of war the demands of the armed services for glycol and allied compounds soon appeared. Of the new oxide capacity of 50 million pounds then installed, almost all avoided chlorine, and only lately has there been sufficient to achieve maximum yields from the oxide facilities available. Instead of expanding production, the civilian supply was minimized, i. e. practically eliminated. The continued scarcity of chlorine was a major factor in delaying the construction of new plants.

Expansion began in 1948, when Wyandotte Chemicals Corp. and Jefferson Chemical Co. began production by the chlorination process followed by an increase by Dow Chemical Co. at Freeport. Last year Carbide installed additional oxidation units at South Charleston and Texas City. It was thought that this was sufficient. However, capacity of perhaps 150 million pounds more is expected in 1951. Most will be contributed by two new producers, Mathieson Hydrocarbon Chemical Co. and Chicago Corp.

This apparently belated expansion is predicated upon continued optimism respecting the anti-freeze market as well as new developments. In the latter category the polyethylene oxide detergents and emulsifiers promise significant growth in the household and industrial field. Probably 10 million pounds of oxide will soon be so required. The ethanolamines appear to gain in favor as absorbents for such acidic gases as hydrogen sulfide and carbon dioxide. At least two producers plan an additional supply as soon as possible. The largest markets are offered by the new textile fibers. Thus, from acrylonitrile come Orlon and Fiber A of E. I. du Pont de Nemours and Co., and the Vinyon N and Dynal of Carbide. Plants will be operating this year at Camden, S. C. and South Charleston, W. Va. Further, du Pont expects to make Delvon next year. This is the terephthalic acid-glycol fiber. While conjectural, prospects are that 50 million pounds of oxide will be consumed for these materials very soon. This is said to be only the start. If true, the anticipated facilities will be needed.

The chlorohydrin process was known to Carius before 1863. Commercialization was an outgrowth of investigations undertaken 50 years later at Mellon Institute, Pittsburgh, Pa. Here, George Curme laid the foundations of a new field of aliphatic chemistry. Together with James Rafferty, the work was continued upon the formation of Union Carbide and Carbon Co. in 1917. Within a short time, ethylene oxide and glycol as well as a long list of allied chemicals derived from petroleum were shown to have commercial promise. Accordingly, Union organized Carbide and Carbon Chemicals Corp. in order to prosecute this work. To this end, the natural gas station of the Clendenin Gasoline Co., W. Va. was immediately acquired and pilot operations began in 1920. These soon showed that profits could only be expected from large-scale production and the project was moved to South Charleston, W. Va. five years later. Ethylene oxide, glycol and Cellosolve were first made. The Carbitols soon appeared together with butyl Cellosolve, and markets were found for di- and triglycols. This group of compounds exhibited the most rapid growth of all of Carbide's chemicals. Within 10 years after initial production, chlorine requirements exceeded 300 tons per day, nearly a third of the domestic supply. This factor became a handicap to attaining full production. While still true, the chlorine process nevertheless accounts for nearly three-quarters of present oxide output.

The partial oxidation of ethylene with oxygen was announced by Reyerson and Swearingen in 1928. Three years later T. E. Lefort obtained a

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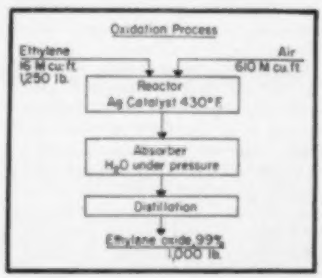

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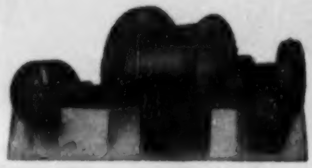

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French patent assigned to the Societe Francaise de Catalyse Generalisee. The catalytic oxidation procedure was claimed. The corresponding domestic patent was acquired by Carbide and became the basis of subsequent production. Carbide remains the only operator of this process although the Chicago Corp. plans comparable facilities for next year.

With over half of the supply, Carbide is still dominant in this field. Next in importance are Dow and Jefferson Chemical Co. The output of Wyandotte is relatively small.

Ethylene Oxide Capacity[1] in Million Lb.

	Capacity (Total)	Chlorination			Oxidation		
		Capacity	Producers	Plants	Capacity	Producers	Plants
1951	[illegible][2]	390	5	6	208	2	4
1950	440	320	4	5	120	1	2
1949	440	320	4	5	120	1	2
1948	302	242	4	5	60	1	2
1947	201	141	2	3	60	1	2
1946	201	141	2	3	60	1	2
1945	201	141	2	3	60	1	2
1944	201	141	2	3	60	1	2
1943	201	141	2	3	60	1	2
1942	201	141	2	3	60	1	2
1941	193	133	2	[3]	60	1	2
1940	148	133	2	2	15	1	1
1939	148	133	2	2	15	1	1
1938	155	140	1	1	15	1	1
1937	130	115	1	1	15	1	1
1936	115	115	1	1	0	0	0

[1]Exclusive of du Pont glycol production deriving from HCHO; all cited include ethylene oxide, per se, as well as glycol equivalent. [2]Capacity frequently quoted at 750 million pounds and several estimate at 650 million value here excludes Hancock; the Mathieson capacity based upon known available chlorine is slightly in excess of 30 million pounds; includes the oxidation of Chicago Corp.; it is also probable that a present producer will increase capacity by about 50 million lb in 1951—an amount not included here. [3]Dow plant at Freeport, Tex. began late this year or in 1942.

Ethylene Oxide Consumption in Million Lb.

		Glycols				Other Chemicals					
		Ethylene Glycol									
	Total	Sub-total	Direct Use[1]	Chemical[2]	Other[3]	Sub-total	Ethylene Cyanhydrin[4]	Ethanolamines[5]	Glycol Ethers[6]	Surface Active & Misc.[7]	Anti-Freeze % of Total Oxide[8]
1950[9]	413	326	277	21	27	86	26	23	26	11	61
1949	354	276	233	19	24	78	20	25	24	9	60
1948	286	228	188	18	22	58	14	18	21	5	58
1947	197	150	118	16	16	47	13	15	16	3	49
1946	160	119	90	15	14	41	12	13	14	2	44
1945	163	125	98	13	14	38	11	12	14	1	44
1944	173	128	100	13	15	45	17	11	16	1	40
1943	171	130	104	12	15	41	16	10	14	1	[10]
1942	165	137	110	11	16	28	9	9	9	1	[10]
1941	128	104	79	11	14	24	2	10	11	1	58
1940	115	97	76	9	12	18	1	7	10	1	60
1939	108	94	75	9	10	14	0	6	8	1	60

[1]Cellophane; coolants; anti-freeze; exports; stocks; some diversion to chemical use is likely especially during 1942–43. [2]Ethylene glycol dinitrate; mono- and diacetate; conversion to di-, tri- and polyglycol. [3]Di-, tri-, and polyethylene glycols; including esters such as diglycol esters of abietic acid, ethyl butyric ester of triglycol, glycol chlorides, etc. [4]Mostly acrylonitrile but includes acrylate esters (not methacrylate). [5]Includes derivatives (see flow chart). [6]Cellosolves (methyl, ethyl, butyl) and Carbitols. [7]Surface active agents of polyglycol type (Igepal, Antarox, etc.); cellulose hydroxyethyl ether (Cellosize); dimethoxytetraglycol, now discontinued; ethylene glycol acetates; etc. — an over-evalutation is quite probable. [8]Estimated in two ways: (1) total ethylene glycol less chemical, export, and other uses and less production from HCHO, i.e. by differences; (2) from trade opinion and reviews previously reported; values for 1942–43 are highly uncertain throwing doubt upon entire distribution of glycol for these years. [9]Estimated from first quarter operations. [10]While civilian consumption can be estimated, the totals available to the armed services precludes other than guesses for all anti-freeze consumption.

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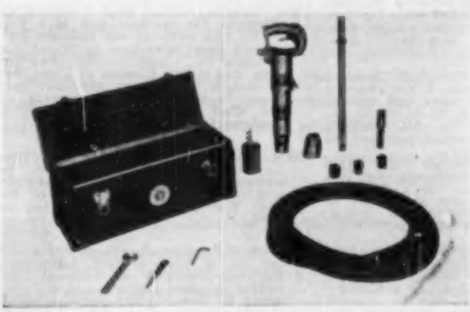

Includes complete S17 Utility Drill and accessories: 14" drill steel—three rock bits, sizes 1 1/16", 1 3/8", 1 1/8" — star drill adapter —chuck driver lock pin— drift key — Allen wrench —end wrench—oil can— and 25 feet of 3/8" air hose, with fittings.

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NEW CONSTRUCTION

	Current Projects		Cumulative 1950	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$68,000	....	$2,068,000	$472,000
Middle Atlantic	268,000	$9,475,000	1,010,000	22,743,000
South	450,000	6,168,000	56,768,000	37,487,000
Middle West	1,343,000	3,882,000	10,909,000	20,914,000
West of Mississippi	28,400,000	10,890,000	104,255,000	47,969,000
Far West	2,718,000	20,100,000	23,954,000	4,350,000
Canada	1,350,000	1,300,000	19,656,000	23,067,000
Total	$34,207,000	$51,906,000	$218,710,000	$157,011,000

Proposed Work

Conn., Wethersfield—Rourke-Eno Paper Co., 58 Allyn St., Hartford, plans to construct a 1 story, 100x500 ft. warehouse and office building on Silas Deane Hy. Estimated cost will exceed $68,000

Idaho, Moscow—Idaho Clay Products, Inc., Moscow, plans to construct a brick manufacturing plant. Estimated cost $150,000

Ind., Newport—U. S. Atomic Energy Comm., 70 Columbus Ave., New York, N. Y., plans to construct a pilot plant for chemical processing at the Wabash River Ordnance Works in Vermilion Co. Estimated cost $500,000

La., Blanchard—Arkansas-Louisiana Gas Co., Slattery Bldg., Shreveport, plans to construct a gas compressor station. Estimated cost $450,000.

Mich., National City—National Gypsum Co., 325 Delaware Ave., Buffalo, N. Y., plans to construct warehouses. Estimated cost $500,000

N. Y., Brooklyn—Presto Plastics, Inc., 5210-24 Avenue U, plans to alter its factory here. Charles M. Spindler, 164 Montague St., Archt. Estimated cost $100,000

O., Cleveland—American Gas Assn., 1032 East 62nd St., plans to construct a 2 story, 100x125 ft. addition to its laboratory and office. Osborne Engineering Co., 7016 Euclid Ave., Archt. Estimated cost $275,000

O., Lancaster—Anchor Hocking Glass Co., 109 North Broad St., plans to construct a 1 story, 150x275 ft. research laboratory building.

Okla., Ada—Ideal Cement Co., Ada, plans to increase the capacity of its plant here from 1,600,000 bbl. to 2,750,000 bbl. Estimated cost $1,000,000

Okla., Yale—Phillips Petroleum Co., Bartlesville, plans to construct 281 mi. 10-in. oil pipe line from Borger, Tex., to Yale. Estimated cost $3,000,000

Pa., Bristol—Patterson Parchment Paper Co., Bristol, plans to construct a factory and office building. Estimated cost will exceed $68,000

Pa., Conshohocken—Lee Rubber & Tire Corp., Conshohocken, plans to construct an addition to its Spring Mill Plant. Estimated cost $100,000

Tex., Freeport—Dow Chemical Co., Freeport, plans to construct a glycol plant to cost $5,000,000; vinylidene plant, $6,000,000; vinyl plant, $8,000,000; styrene plant, $3,500,000, and power plant $750,000

Tex., Marshall—Texas-Illinois Natural Gas Pipe Line Co., 20 North Wacker Dr., Chicago, Ill., plans to construct a pipe line booster station and a pipe line maintenance warehouse at Darco about 8 mi. south of Marshall. Estimated cost $900,000 and $250,000 respectively.

Utah, Salt Lake City—The Filtrol Corp., 634 South Spring St., Los Angeles, Calif., plans to construct a manufacturing plant. Estimated cost $2,500,000

Wash., Seattle—California Ink Co., 2627 Western Ave., plans to construct a 1 story ink manufacturing plant. Estimated cost $68,000

Ont., Niagara Falls—Canadian Cellucotton Products Co., Ltd., 431 Victoria St., plans to construct a 4 story factory. Estimated cost $1,250,000

Ont., Rodney—Great Lakes Paint Co., William C. Curtis, Mgr., plans to construct a 2 story factory. Estimated cost $100,000

Contracts Awarded

Ala., Birmingham—Barrett Div. of Allied Chemical & Dye Corp., c/o contractor, has awarded the contract for a warehouse (first unit of manufacturing plant) to Brice Building Co., 130 South 13th St. Estimated cost $68,000

Calif., Los Angeles—Procter & Gamble Co., 1151 South Bway., will alter its warehouse at 1601 West 7th St. Work will be done by owners. Estimated cost $100,000

Del., Newark—National Vulcanized Fibre Co., Newark, has awarded the contract for a 1 story, 60x520 ft. factory to William N. Worrall, 220 South Union St., Kennett Sq., Pa. Estimated cost $150,000

Ill., Chicago—Packit Envelope & Bag Co., 4040 West Ogden St., has awarded the contract for a factory to contain 45,000 sq. ft. space to Campbell, Lowrie, Lauthermilch, 400 West Madison St. Estimated cost $250,000

Ill., Skokie—G. D. Searle & Co., Skokie, has awarded the contract for a pharmaceutical plant and laboratory to George A. Fuller Co., 111 West Washington St., Chicago. Estimated cost $750,000

Idaho, Arco—Atomic Energy Commission, 1901 Constitution Ave., N. W., Washington, D. C., has awarded the contract for a reactor testing station to Fluor Corp., 2500 Atlantic Blvd., Los Angeles, Calif. Estimated cost $20,000,000

La., New Orleans—Radal Southern Corp., c/o George L. Dahl, Architects & Engineers, Archts., 2101 North St. Paul St., Dallas, Tex., has awarded the contract for a warehouse and office for U. S. Rubber Co., to Perrilliat-Rickey Construction Co., P. O. Box 7027. Estimated cost $100,000

O., Avon Lake—B. F. Goodrich Chemical Co., Rose Bldg., Cleveland, has awarded the contract for a sales and service laboratory building to H. G. Slatmeyer & Son Construction Co., 203 Lakeside Ave., Cleveland. Estimated cost $500,000

O., Mt. Vernon—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., has awarded the contract for a 2 and 3 story plant, warehouse and office to Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $2,000,000

O., St. Bernard—Emery Industries, June and Long Sts., has awarded the contract for a 1 story factory to Dawson Evans, St. Bernard. Estimated cost $180,000

Pa., Bradford—Kendall Refining Co., Bradford, will construct a platforming refining plant. Work will be done under supervision of Universal Oil Products Co., 310 South Michigan Ave., Chicago, Ill., Engrs. Estimated cost including equipment $8,000,000

Pa., Bristol—Rohm & Haas Co., Washington Sq., Philadelphia, has awarded the contract for a laboratory and office building to Frank V. Warren, Inc., 925 West Thompson St., Philadelphia. Estimated cost $250,000

Pa., Pittsburgh—Penn Oil & Lubricating Co., 4 Kingsland Dr., has awarded the contract for two warehouses to B. Dinatle, 6604 Apple Ave. Estimated cost $75,000

Pa., Rouseville—The Pennzoil Co., Oil City, has awarded the contract for enlarging its oil refinery to included a propane-deresining, resins and fractioning unit, to M. W. Kellogg Co., 225 Bway., New York, N. Y. Estimated cost including equipment $1,000,000

Tex., Dallas—General Portland Cement Co., Republic Bank Bldg., will construct a cement plant unit. Work will be done by owners with subcontracts. Estimated cost $500,000

Tex., Freeport—Dow Chemical Co., Freeport, has awarded the contract for Unit 3 of ethylene glycol plant to Austin Co., M & M Bldg., Houston, estimated cost, $4,000,000; Unit 4 in light hydrocarbon plant to J. F. Pritchard & Co., Gulf Bldg., Houston, estimated cost, $3,000,000; Unit 5 in chlorine plant to Tellepson Construction Co., 1710 Telephone Rd., Houston, estimated cost $2,750,000. Estimated grand total $9,750,000

Tex., McKee—Shamrock Oil & Gas Corp., McKee, will reconstruct treater unit of gasoline refinery. Work will be done by owners. Estimated cost $90,000

Tex., Orla—Pecos Petroleum Co., Pecos, will construct a gasoline plant absorption unit to have a daily capacity of 26,000 gal. Work will be done by owners. Estimated cost $425,000

Tex., Waxahachie—Southland Cotton Oil Mill, Waxahachie, will construct a cotton oil mill plant. Work will be done by owners. Estimated cost $125,000

Va., Roanoke—Lone Star Portland Cement Co., 342 Madison Ave., New York, N. Y., has awarded the contract for a cement plant near here to Walsh Construction Co., 1 East 43rd St., New York City, and Ralph E. Mills Co., Inc., 1210 Tennessee St., Salem; silos and packhouse to MacDonald Engineering Co., 188 West Randolph St., Chicago, Ill. Estimated cost $6,000,000

Wis., Milwaukee—Pittsburgh Plate Glass Co., 235 East Pittsburgh Ave., has awarded the contract for a warehouse and office to Ray J. Mothe Co., Inc., 2901 West Rohe Ave. Estimated cost $203,000

Ont., New Toronto—Goodyear Tire & Rubber Co. of Canada, Ltd., Lake Shore Rd., has awarded the contract for a 40x240 ft. plant addition and a 2 story, 44x98 ft. power plant addition to The Carter Construction Co., Ltd., 419 Cherry St., Toronto. Estimated cost $1,000,000.

Que., Montreal East—Canadian Oil Companies, Ltd., 304 Richmond St., Toronto, Ont., has awarded the contract for a lubricating and grease plant on Notre Dame St., to Fluor Corp. of Canada, Ltd., 11175 Sherbrooke St., Montreal. Estimated cost $300,000

Que., Montreal—Rosenbloom Paper Supply Co., Inc., 6744 Hutchinson St., has awarded the contract for a 1 story, 120x126 ft. factory addition to Ain & Zakata, Ltd., 6910 Wiseman Ave., Outremont. Estimated cost $90,000

ANTARA®

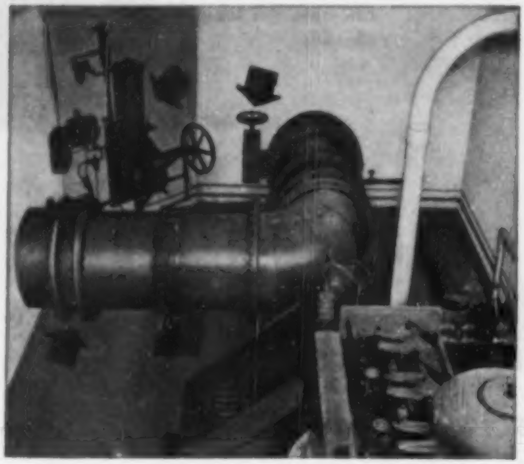
SURFACTANTS*

For example . . .
A SURFACTANT
can make an insecticide work sooner, harder or longer

***a Surfactant is a surface active agent**

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



TULSA WATER SUPPLY

Increased in Record Time

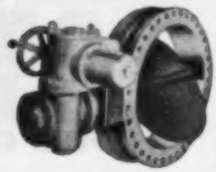
The City of Tulsa Water Department increased its water supply from twenty-four to minimum requirements of thirty-five million gallons a day without constructing a second gravity flow line. This was accomplished by means of booster stations at strategic points.

The fifteen R-S Valves supplied for this emergency operation ranged in size from 36-inch handwheel operated to 60-inch air cylinder operated with handwheel declutching units. After delivery, these valves were slipped into the line in a matter of hours. The entire project was completed in remarkably fast time. Due to an improvement in vane design, the flow rate in R-S Heavy Duty Valves (12-inch and larger) has been increased approximately 25% in the wide open (77½°) position. In case after case, the saving in pumping (or blower) costs will pay for an R-S Valve in short order based on "K" values alone.

Consult with your local R-S Valve Engineers. Look for the address and phone number listed under "R-S Products, Valves" or write direct.

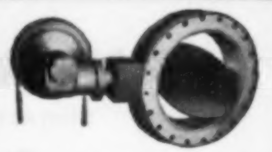
R-S PRODUCTS CORPORATION
Wayne Junction · Philadelphia 44, Pa.

No. 700—20-inch 50-pound Cast Iron Valve with rubber seat, Type B-8934, for positive 100% shut-off. Heavy duty handwheel control with threaded reach rod. Type B-9469.



No. 724—42-inch 50-pound Heavy Service Valve, B-9813, complete with limitorque motor and gear reduction drive No. 4. Angular seating vane for wedge-type closure with metal seat. Rubber seat available if desired. Valve body good for 125 psi gauge static head and drip tight shut-off at 50 psi pressure drop with rubber seat.

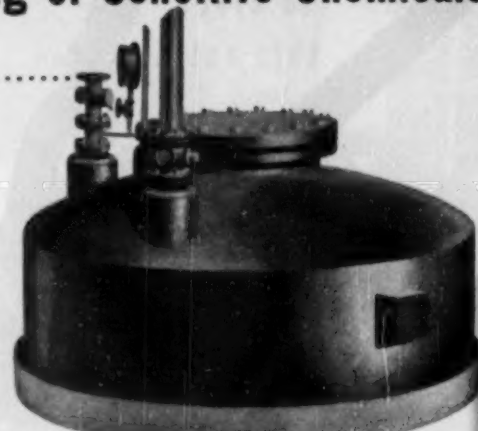
No. 768—66-inch Fabricated Steel Handwheel Operated Valve with ends scraffed for welding. 6½-inch diameter one piece Stainless Steel shaft mounted on thrust bearings (valve installed with shaft vertical). Horizontal and vertical ribs on body prevent distortion when machining and assembling. Stuffing box easily repacked. Used to control river flow during dam construction. Open atmospheric discharge.



No. 737—20-inch 50-pound Heavy Service Valve (B9804) with rubber seat (B8934). Gear reduction drive No. 3 with chainwheel.

ONE OF A SERIES DEMONSTRATING APPLIED LUKENOMICS

How to Get Test-Tube Accuracy in Production Weighing of Sensitive Chemicals



PROJECT: *To provide economical, efficient, automatic weighing of chlorinated hydrocarbons used in production of a high-purity plastic. Discoloration and other contamination of chemicals must be prevented. To maintain their stability, they must be kept at sub-zero temperatures.*

DESIGN: *Jacketed weigh tanks on suspended scales. Inner tank shell of Lukens Nickel-Clad Steel; outer tank shell of carbon steel, externally insulated. Circulation of coolant provided for by passage between shells. Fast, uniform heat transfer assured by nickel-clad steel walls. Resistance to chemical attack and prevention of metallic pick-up provided by nickel interior of inner tank; strength and rigidity, by its steel backing.*

END RESULT: *Fast, accurate, automatic weighing of stable, pure, color-true chemicals. Easy, low-cost maintenance. Long equipment life.*

These benefits are typical of results achieved with newly developed, more efficient processing equipment. And wherever design, fabrication and materials selection must be critically coordinated, you will find the economical answer in applied *Lukenomics*. Lukenomics combines the experience of designers, engineers and equipment builders with Lukens' knowledge of materials and their application, gained over 140 years as the world's leading producer of specialty steel plates, heads and steel plate shapes.

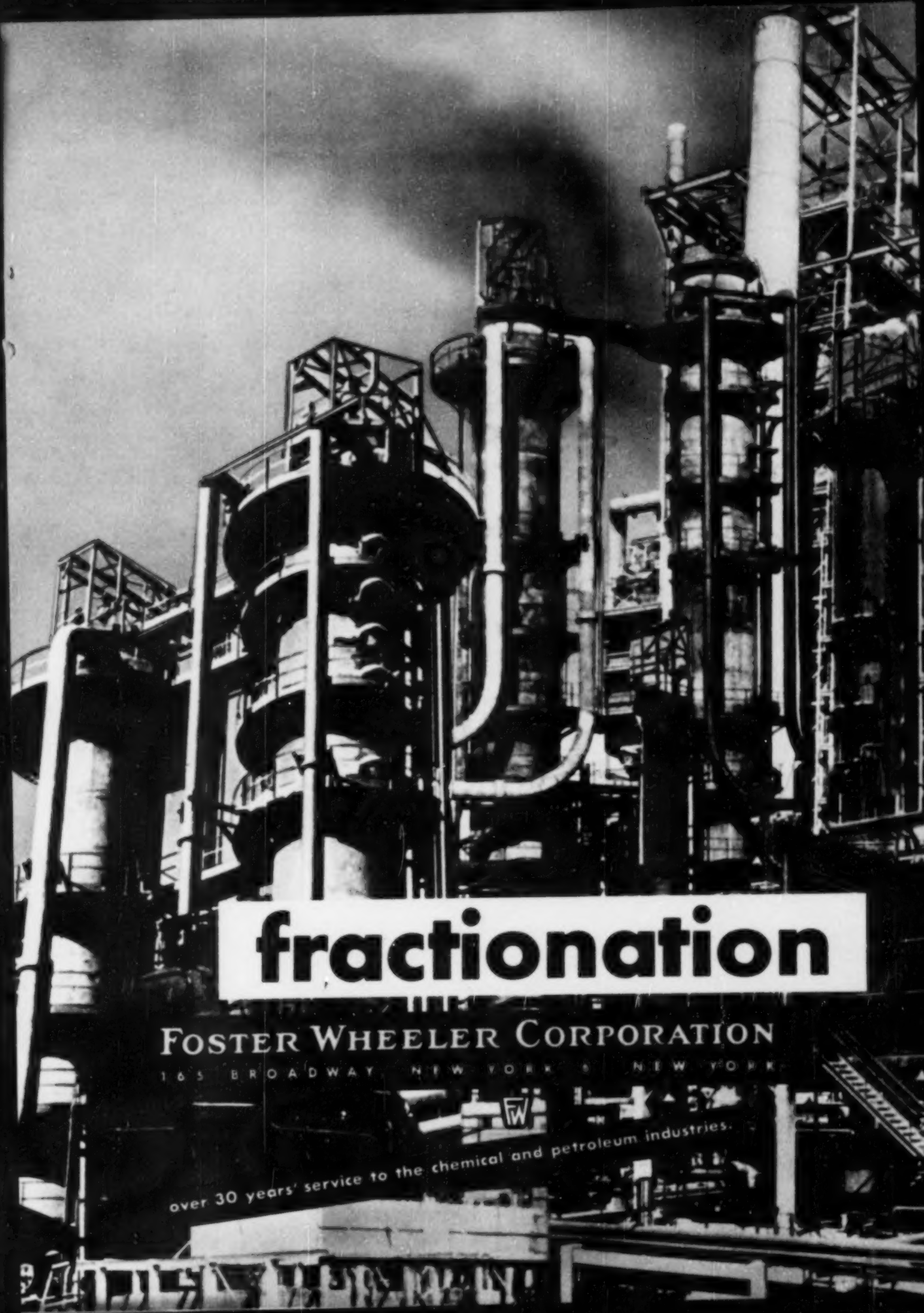
It's sound investment insurance to put Lukenomics to work on your equipment problems. There are progressive fabricators who can do this for you. Get in touch with them or write our Manager of Marketing Service, stating your problem. There's a Lukenomics team ready to go to work on it. Lukens Steel Company, 400 Lukens Building, Coatesville, Pa.

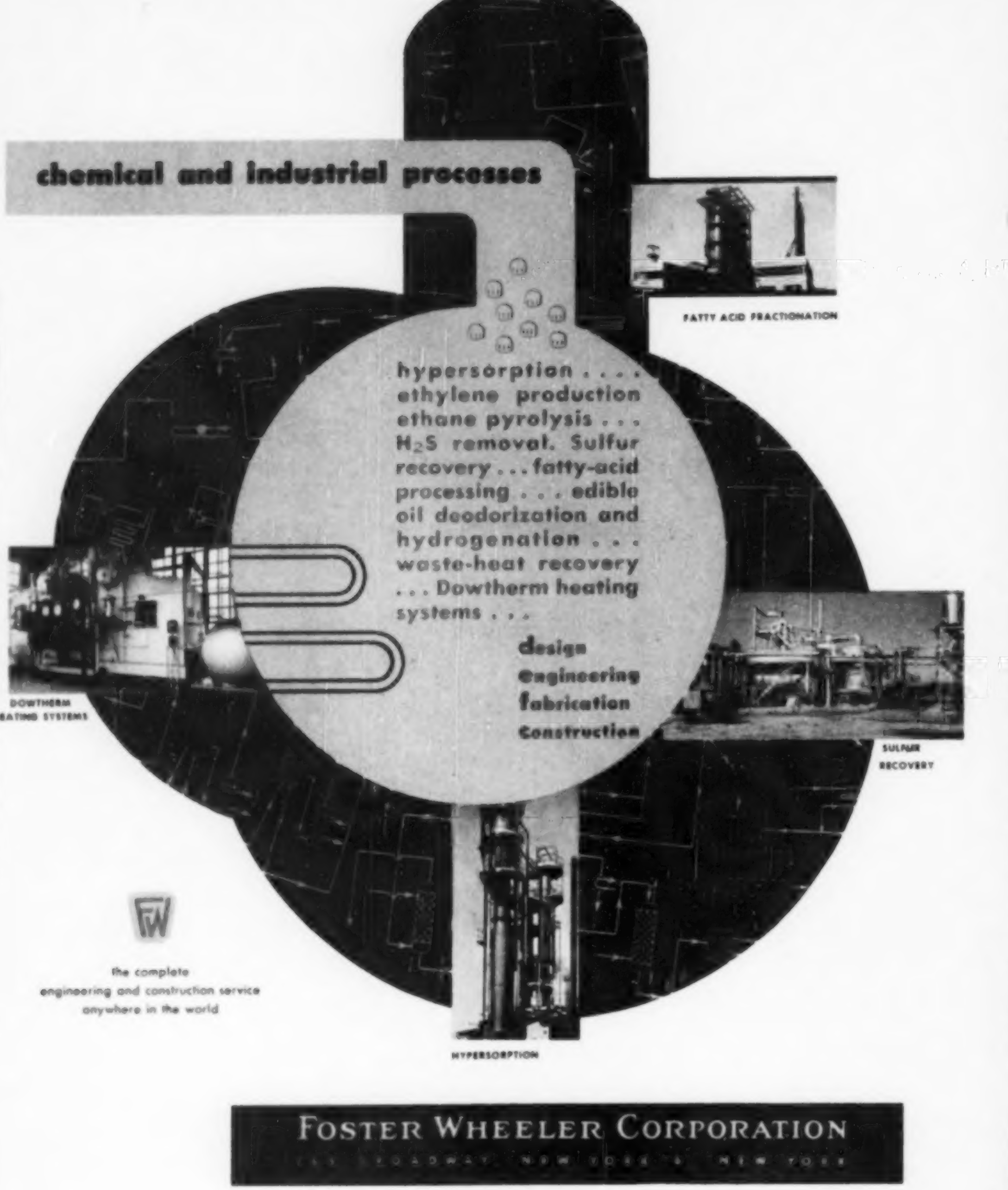
The above weigh tanks, designed and used by a nationally-known chemical company, were fabricated by The Ohio Machine and Boiler Co., using Lukens Nickel-Clad Steel.

LUKENS

LUKENS STEEL COMPANY

BETTER PRODUCTS FOR BETTER EQUIPMENT


fractionation
FOSTER WHEELER CORPORATION
165 BROADWAY · NEW YORK 6 · NEW YORK
over 30 years' service to the chemical and petroleum industries.


chemical and industrial processes
hypersorption . . . . ethylene production ethane pyrolysis . . . H_2S removal. Sulfur recovery . . . fatty-acid processing . . . edible oil deodorization and hydrogenation . . . waste-heat recovery . . . Dowtherm heating systems . . .
design
engineering
fabrication
construction
FATTY ACID FRACTIONATION
DOWTHERM HEATING SYSTEMS
SULFUR RECOVERY
HYPERSORPTION
the complete engineering and construction service anywhere in the world
FOSTER WHEELER CORPORATION

WHERE TO BUY

Featuring additional Equipment Materials, Supplies and Service for the Process Industries

NEW ADVERTISEMENTS

received by July 20th will appear in the August issue subject to limitations of space available.

Address Copy to the Classified Advertising Division

Chemical Engineering
330 West 42nd St., New York 18, N. Y.

Make it a HABIT . . . to check this page —EACH ISSUE

This WHERE TO BUY Section supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the process industries.

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • **OPPORTUNITIES** • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:
(Not available for equipment advertising)
$1.20 a line, minimum 4 lines.
To figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

INFORMATION
BOX NUMBERS, care publication New York, Chicago or San Francisco offices count as one line additional in undisplayed ads.
DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:
The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
C. E.

NEW ADVERTISEMENTS received by 10 A. M. July 26th at the New York Office, 330 W. 42nd St., New York 18, N. Y., will appear in the August issue subject to limitations of space available

WANTED
FOR CHEMICAL PLANT
LOCATED IN SOUTH

ESTIMATORS

Must be experienced engineers, under 40, familiar with Refinery and Chemical Plant design and capable of estimating process equipment installations from flow diagrams and specifications. Give full information, experience record and salary expected.

DRAFTSMEN-DESIGNERS

Preferably with ME, CE, or EE degree, under 40, with at least three years drafting experience in Chemical or Oil Industry. Give full information, experience record and salary expected.

P-6846, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

RESEARCH CHEMIST

Excellent opportunity for Research Chemist with good technical background and experience in shoe and leather chemicals, especially shoe finishes. Desirable locality with reliable concern. Reply stating full experience and qualifications. All information will be held in strictest confidence.

P-6736, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

ENGINEER
INSTRUMENT FIELD

Graduate mechanical or electrical engineer to do development and application engineering in the instrument field primarily on temperature detectors. Several years' development experience in the instrument or allied field desirable. Write giving full particulars.

LEEDS & NORTHRUP CO.
4901 STENTON AVENUE
PHILADELPHIA 44 PA.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

ENGINEER 25 to 30 years for training in research and product application for preservation of equipment in the public utility and marine field. Applicant should be capable of independent research, of meeting design, plant operation and research heads, and of preparing and delivering papers to technical groups. Travel, with headquarters in New York. P-6855, Chemical Engineering.

SELLING OPPORTUNITY OFFERED

SALES ENGINEER: To Represent on commission basis Manufacturer of Heat Transfer Equipment in Middle west and South Atlantic States. RW-6832, Chemical Engineering.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 260 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. B, 241 Orange St., New Haven, Conn.

CHEMICAL AND Sanitary Engrs.: University Instructors to Dept. Heads at $8000. Nation Wide coverage. Give Phone, Photo, Qualif. Cline Teachers Agency, East Lansing, Mich.

POSITIONS WANTED

CHEMICAL ENGINEER: M.S., age 29, now employed. Six years process development, patents, honors. Seek new position in chemical or food industry. West Coast preferred, consider others. PW-7069, Chemical Engineering.

CHEMIST-M.S.—10 yrs. experience laboratory apparatus manufacturing. Creative and good organizer. Desires responsible position. PW-7130, Chemical Engineering.

SELLING OPPORTUNITIES WANTED

ADDITIONAL PRODUCTS desired by technical, aggressive sales representative currently contacting Chemical, Food and Industrial Plants in Midwest. RA-6941, Chemical Engineering.

CHEMICAL ENGINEER — young, ambitious and aggressive wishes to offer technical representation and service in the Midwest to reputable chemical and equipment houses in basic chemicals, metals and allied lines. Agency basis preferred. RA-7016, Chemical Engineering.

SALES REPRESENTATIVE. Metallurgist, established in Chicago for 15 years, wants additional account. Well established contacts with leading chemical, pharmaceutical, food and beverage industries. Stainless steel specialist. RA-7119, Chemical Engineering.

ENGINEER

. . . for development engineering on industrial process instruments used in the chemical industry. Prefer applicant with degree in chemical engineering and several years' experience in the chemical field. Knowledge of electronics and physics desirable. Write giving full particulars.

LEEDS & NORTHRUP CO.
4901 STENTON AVENUE
PHILADELPHIA 44, PA.

EDIBLE OIL EXTRACTION

WANTED: Sales Group or Fabricator to promote sale Hildebrandt Type Extraction Equipment. Consulting or employment basis. Complete design. Patent protection

RW-7014, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

POSITION AVAILABLE

Civil Engineering graduate with minimum 12 years' experience to supervise project engineers on building work, waste disposal and structural design. Scheduling experience also desirable. Location in East with established chemical company. Furnish detailed resume of experience and education, also salary requirements, in reply.

P-6886, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

CHEMICAL ENGINEER

High standing. Research, development and general chemical engineering. Old established progressive manufacturer industrial inorganic chemicals. Fine opportunity join growing organization. Give complete information including scholastic ranking and snapshot photo if available.

CHICAGO COPPER & CHEMICAL CO.
Blue Island, Illinois

ENGINEERS
CHEMICAL and METALLURGICAL

Investigate our active confidential service for the better position. Appointments at your convenience.

Call, write or wire: **GLADYS HUNTING**
DRAKE PERSONNEL
7 W. Madison St. Chicago 2, Ill.

Engineers - Executives - Technical Men

Salaried Positions, $4,000 to $30,000. This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

TOMSETT ASSOCIATES
1204-2 Berger Bldg. Pittsburgh 19, Pa.

EMPLOYMENT . . . EQUIPMENT . . .
BUSINESS

OPPORTUNITIES

Whatever your need—
think "SEARCHLIGHT" FIRST

TEXAS

Professional Engineer Graduate and Post Graduate V. P. I., and M. I. T., with 35 years varied experience in the Chemical Industry interested in opening engineering office in Houston to undertake commissions for individual or firms having business interests there and to represent equipment manufacturers.

RA-7067, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

INDUSTRIAL PLANTS FOR SALE

Taunton, Mass. 180,000 sq. ft.

Yankton, So. Dak. 25,000 sq. ft.

With adequate land for expansion. RR sidings immediately alongside plants. Both reconstructed and re-equipped 1943 for producing industrial or beverage alcohol (at Yankton, from local grain). Also suitable for rapid conversion for chemicals, pharmaceuticals, paints, detergents, corn or soy products, livestock premium supplemental feeds, tanning, bleaching, dyeing, plastics or processes using distillation, pressurized steam conversion, tankage and large steam producing equipment. Unusually favorable cooling water facilities. Samuel S. Warner, Room 612, Empire State Bldg., New York, New York, or your own broker.

NEED REPRESENTATION IN INDIA?

U. S. trained, experienced Chem Engr. (D.Ch.E.) shortly returning to India is interested in representing American Manufacturers of equipment, chemicals and instruments.

RA-7067, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

Opportunity... the position . . . you want in industry!

Our background of personalized service and proven methods points the way to job satisfaction for you. This is not an employment agency but a company specializing in showing you exactly how to "sell yourself" to the prospective employer of your choice in an administrative or technical position.

Send $5.00 for questionnaire. After you give us the necessary information, we will furnish you a portfolio containing an attractive and correctly prepared resume of yourself, a letter to send to prospective employers and a compilation of tested methods of selling yourself. After you have examined this, we will bill you $10.00, making a total cost (no extras) of only $15.00 for the complete, valuable service.

PLACEMENT COUNSELORS CO.
Munsey Building *Baltimore 2, Md.*

AVAILABLE . . .

CUSTOM REFINING FACILITIES . . .

- Distillation
- Extractions
- Separations
- Fractionations

Drum Lots—Tank Cars

WANTED . . .

- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

TRULAND
CHEMICAL & ENGINEERING CO., INC.
Box 426, Union, N. J. UNionville 2-7260

SOLVENT PILOT PLANT

Complete Allis-Chalmers solvent extraction pilot plant using Hexane as the solvent and including solvent recovery equipment. Capacity 300-400 lbs. soybeans per hour. Used very little—three years old.

E. J. GEHRIG
THE QUAKER OATS CO.
MERCHANDISE MART, CHICAGO 54, ILL.

PRODUCT FOR SALE?

Do you have a capital goods type product that can be sold to the petroleum and chemical industries but lack . . .

ADEQUATE FINANCING?
PRODUCTION FACILITIES?
SELLING ORGANIZATION?

A nationally known and long established manufacturer in the capital goods field is interested in purchasing a product or products that will complement its present line.

The product must have its major sales potential in the petroleum and chemical industries, be adaptable to present manufacturing facilities.

If you are the owner of such a product and are contemplating its sale because of manufacturing or marketing difficulties, please write.

All replies will be treated with the strictest confidence.

BO-0684, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

CASH PAID

For Capital Stock or Assets of

CHEMICAL PLANT

• WANTED

By large financially powerful diversified organization wishing to add another enterprise to present holdings.

Existing Personnel Normally Retained

Box 1221
1474 B'way N. Y. 18, N. Y.

DRYER FOR SALE

EXTRAORDINARY BARGAIN

One Link Belt Multi-Louvre Dryer #818 In Actual operation less than one month Perfect condition. Now dismantled in dry storage. Present market value approx. $16,000.00. Will sacrifice for $6,500.00 F.O.B. cars Pittsburgh. Speed 66 F.P.M. Air Heater 900,000 BTU/hr; Cyclone Collector; Exhauster 1710 CFM; Gas Mixer; Combustion Blower; Controls; Motors and Auxiliaries

CALGON, Inc.
323 Fourth Avenue Pittsburgh, Pa.

WANTED—SOLVENT

Wastes of All Kinds
REDISTILL OR PURCHASE
Also Surplus Chemicals, Dyes, Pigments, Oils, etc., By-Products, Residues, Equipment
CHEMICAL SERVICE CORP.
80-84 Beaver St. New York 5, N. Y.

FOR SALE

PREFORM MACHINES

- 2 Stokes Model DDS-4
- Reeves Drives and Motors
- Colton Model 5½ T.M.D.
- Stokes Model T.M.D.
- Stokes DDS-2 M.D.

Please write:

FS-7000, Chemical Engineering
330 W. 42nd St., New York 18, N. Y.

Compressors Wanted

STATIONARY - PORTABLE
LARGE OR SMALL
L. W. BAUER
22 Barnett Street Bloomfield, N. J.

WANTED

12,000 GALLON
TOTALLY ENCLOSED TANK

Rubber or Resin Lined or Stainless Steel. Vertical type preferred.

SYNVAR CORPORATION
WILMINGTON, DELAWARE

WANTED

One Constant Weight Feeder

To handle dry material at rate of 100 to 5,000 pounds per. Please give full information as to condition, location, price etc.

W-0000, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

When You Buy Used Machinery

BE SURE and Buy from a Reputable Dealer

VACUUM DRYERS

3—Rotary Vacuum Dryers: 5' x 33' and 5' x 25' Devine; 4 x 20' #59-C Stokes; 3 x 15' #59-B Stokes; each complete with auxiliary equipment.
4—Vacuum Shelf Dryers: #4-C Devine with 9—40" x 43" shelves; #11 Devine, 17—40 x 43" shelves; Devine with 18—59" x 78" shelves; Devine #23 with 13—59 x 78" shelves; 29—40 x 43" extra welded vacuum dryer shelves.
1—Vacuum Drum Dryer, double rolls, each 42" dia. x 120", complete, made by Buffalo F. & M. Co.—Also 5' x 10'6" Devine with single bronze drum.

1—6' x 60' LOUISVILLE ROTARY STEAM TUBE DRYER, with unused and welded Steel shell and tubes, 27—4½" and 27—3" tubes.
2—5'4" x 40" RUGGLES COLES STAINLESS STEEL ROTARY DRYERS, for direct heat or low temperature hot air.
2—6' dia. x 8' OLIVER STAINLESS STEEL trough type CONTINUOUS VACUUM FILTERS.

RUBBER SHRIVER FILTER PRESSES

3—36" x 36" Shriver Rubber Filter Presses, semi-hard 1½" rubber plates, rubber covered 3" cast iron frames; 4-eye, corner feed, closed delivery, washing type. Each 18 chambers. Each with 50-ton Seco closing device.

1—30" x 30" ALUMINUM PLATE AND FRAME FILTER PRESSES, Sperry-43 Chambers, side feed, open delivery, used on pectin. In excellent condition.
1—8' x 15' Oliver Precoat Filter.
2—#12 SWEETLAND FILTERS, 36 leaves on 4", also 72 on 2".
1—42" x 42" SHRIVER FILTER PRESS, Cast Iron, Plate and Frame, Open Delivery, 41 Chambers; also 39" x 39" Kilby, 46 plates, 47 frames.
2—930 gal. closed, jack., agit. STEEL KETTLES, 10 H.P. Motors & drives.
1—VACUUM SHELF DRYER, 17 shelves, 40" x 43".
1—300 gal. PATTERSON HIGH CHROME MANGANESE BALL MILL, 54" x 54", jacketed, with drive and motor.
1—J. H. Day ALUMINUM Horiz. 1,000# DRY POWDER MIXER.
1—8' x 12' OLIVER ACID-PROOF FILTER, lead fitted.
2—SIMPSON INTENSIVE MIXERS—#2, 6' dia.; #1½, 4' 6" dia.
1—2,000 gal. STEEL KETTLE, jack. open top, agit., 7' x 7'6".
2—BAKER PERKINS MIXERS, size 17. Jacketed, 200 gallon.
1—ROTARY VACUUM DRYER, 5' x 33'.
1—6' x 12' ALLIS CHALMERS ROD MILL.

Baker Perkins heavy duty dispersion mixer—stainless steel, 100 gal. working capacity hydraulic tilt, suitable for vacuum, with drive and 60 HP motor, complete.

THE KEY TO SAVING TIME AND MONEY

CONSOLIDATED

PRODUCTS COMPANY, INC.

15 Park Row, New York 7, N. Y. BArclay 7-0600

BE SURE—A reputable dealer wants to serve you always and will often sell you for less than what you would pay an Auctioneer or a private seller, off the floor of a plant.

Furthermore his quotation to you usually includes dismantling and loading on car or truck, so that his price is your cost, and you pay no extras.

Furthermore you buy from a reputable dealer with the assurance that whatever representations he makes will be lived up to, because he wants your business again. "Caveat Emptor" (let the buyer beware) is as obsolete as last week's newspaper, so far as our customers are concerned. So, when you want good Used Machinery, see us and BE SURE.

We Want to Buy Your Idle Machinery from Single Items to Complete Plants

Send us your list.

RECONDITIONED by BRILL - - BACKED by BRILL

When you "BUY BRILL" you buy equipment reconditioned by BRILL in THEIR OWN SHOP and under THEIR OWN SUPERVISION where only the HIGHEST STANDARD is accepted.

FILTERS

3—Sweetland #12, with 36 leaves, 4" centers.
1—Sweetland #7, with 28 leaves.
2—Sweetland #2, stainless, with 12 leaves.
6—Oliver Rotary Vac. 11'6" x 18', 8'x12', steel.
1—Swenson 4'x5' Rotary Vac. steel drum.
1—Oliver Rotary Vac. 3'x2', wood drum.
2—Shriver 12"x12" P&F, 12 chambers. C.I.
2—Sperry 30"x30" bronze, P&F, 30 chambers.
1—Shriver 30"x30" C.I., P&F, 30 chambers.
12—Shriver, Sperry Skeletons and wood P&F, 18" to 42".
2—Vallez #40 Pressure Filters, 31 leaves.

SCREENS

6—Rotex Screens, 20"x48", 40"x84", 40"x120", Single and Double Deck.
6—Tyler Hummer 4'x10', 4'x8'.

KETTLES—EVAPORATORS

4—Steel 2000 gal. steam jacketed, agitated.
1—Steel 250 gal. open top, jacketed, agitated.
10—Stainless 20 to 300 gal., jacketed.
50—Steel Tanks, Horizontal and Vertical, to 850,-000 gals.
4—Stainless Vertical Tanks, 7'3"x14', with side entering agitators.
2—Stainless Horizontal Tanks, 6'3"x14', with stainless coils.
2—Buflovak 6' dia. Crystallizers.
1—2'x15' Jacketed Crystallizer.
6—Copper Vac. Stills 75 to 500 gal.

PULVERIZERS AND MILLS

2—Raymond 4-roll and 3-roll High Side Mills with separators, cyclones, dust collectors, etc.
3—Abbe 36"x42" porcelain-lined Pebble Mills.
2—Patterson 6'x5' silex-lined Pebble Mills, m.d.
2—Rodgers 3'x4', 2'x3' Pebble Mills.
1—Patterson 3'x10' steel Tube Mill, m.d.
1—Hardinge 5'x22" Conical steel-lined Ball Mill with feeder, classifier and motor.
5—Mikro Pulverizers, 4TH, 2TH, 2DH, 1SH.
2—Premier Colloid Mills 8", 4" dia., S.S.

MIXERS—ALL TYPES

1—Banbury #00 Mixer with 10HP motor & forced feed lubrication.
5—Baker Perkins 100, 50, 20 and 9 gals., jacketed Double Arm.
1—Baker Perkins 2-gal. Stainless, Double Arm.
1—Day #5 Cincinnatus, jacketed, Double Arm. 100 gal.
10—Day, Robinson 100# to 2000# Powder Mixers.
1—Gruendler 4000# Steel Powder Mixer.
1—Munson 82 cu. ft. steel Conical Blender.
25—Electric Portable Agitators, 1/4HP to 5HP.

DRYERS—KILNS

4—Ross Eng. 2-Truck Atmospheric Dryers, steam-heated, 300 sq. ft. drying surface: has single units or multiples.
2—Buflovak 4'x9', 32"x100", 32"x72", 24"x60" Atmospheric Double Drum.
5—Buflovak 5'x12', 3'x4', 4'x9', 4'x8' Single Drum Dryers.
6—Allis Chalmers Rotary Kilns 9'6"x250', 7'6"x125', 9'x80', 6'x40', 4'x50', 3'x30'.
5—Ruggles-Coles 6'x40 Stainless Rotary Steam Tube Dryers.
4—Louisville 6'x50', 6'x25', 4½'x35', 30"x20" Rotary Steam Tube Dryers.
3—Stokes, Devine Rotary Vac. Dryers, 18"x42", 30"x8', 5'x25', 5'x30'.

CENTRIFUGALS

2—AT&M 40" and 40" Suspended Type with stainless steel imperforate and perforated baskets, bottom discharge, m.d.
1—AT&M 40" Suspended, monel perforated.
1—Tolhurst 40" Suspended, rubber perforated.
1—Fletcher 32" Suspended steel imperforate.
1—Tolhurst 32" Suspended monel perforated.
1—AT&M 26" Suspended stainless imperforate.
1—Tolhurst 26" Steel perforated.
2—Tolhurst 20" rubber-covered baskets.
1—Bird 18"x28" monel, solid bowl, continuous.
2—Bird 36"x50" solid bowl, continuous.
1—Sharples #16V stainless, 2HP motor.

MISCELLANEOUS

1—Knapp #429 Carton Sealer with Compression Unit.
6—Anderson Duo. #1 Expellers.
4—Nash, Hytor Vacuum Pumps, to 300 cfm.
6—Olivite acid-proof Centrifugal Pumps, 2½"x2", m.d.
3—Rodgers, Stokes & Smith Powder Fillers.
2—Knapp Automatic Can Labelers to #10 cans.

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BOILER—Dowtherm, 500,000 BTU, 125# pressure, Natl. Board, gas fired.

WEMCO CLASSIFIER—No. 78, Type SH spiral classifier, 32' long. (UNUSED.)

DRYERS—Buflovak, single drum, Vacuum, 24"x20" S.S. drum, vari-drive with pump.
Spray, 3'6", S.S. electrically heated.

TRUCK DRYING OVEN, 6'8"x12'x12', complete. (UNUSED).

FILTERS—8'x10' Oliver, continuous.
8' x 6' Oliver cont., SS Type 304. (UNUSED).
8'x12' Oliver, continuous, precoat.
3' dia. x 1' face, Oliver, top feed, C.I. 9 sq. ft.

KILNS, DRYERS, COOLERS — 3'x35' Bonnot.
4'x30' Traylor.
7'x45'x½" Link Belt.
6' x 40' Bonnot.
9'x24' Link Belt, Roto Louvre.

MIXERS—Blystone, heavy duty, 4'x6'7". Jacketed, ribbon, S.S. clad, S.S. ribbon agitator.
No. 3 Super Ajax, 178 gals.

PIPE & FITTINGS—Haveg, 2" to 30". Karbate, ½" to 6".

PUMPS—Vacuum, Stokes, 212C, 100 CFM.
Wilfley, S.S., 150 GPM @ 100' head.
La Bour, C.I., 200 GPM @ 50' head. with alloy impeller & trim.
Nash Hytor, Vacuum, size H8, (Unused)

TANKS—4000 gal., hor. 5'x30'3"x5/16" (NEW).
2900 gal., hi-chrome, 6'6"x10'x⅝" (Unused).
25000 gal., rubber lined, 13'x25'x⅝" (Unused).

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1 Motor driven portable belt conveyor.
1 W & P Double-Armed Lab. Mixer.
10 8" Premier Colloid Mills, Water-Cooled.

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2—30 ton diesel operated switching locomotives new 1942, Full ICC.
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1—25 ton, Ohio, steam, new 1942.

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4—Bird Stainless Steel, Continuous Type, Solid Bowl, Filters, 18" x 28", Condition Unused.
2—Hercules Stainless Steel Filters, #50, Unused.
1—Sperry, 24" x 24" Filter Press, Closed Delivery, 22 Chambers.
3—Shriver Plate & Frame Laboratory Filter Presses, 7" x 7".
1—Shriver 30" x 30", Closed Delivery, Filter Press, 28 Chambers.

1—Pfaudler, Glass-Lined Jacketed Reactor, 80 gal. with Impeller Type Agitator.
3—Buffalo, Jacketed, Vacuum, Reactors, 1500 gals.
3—Stainless Steel Jacketed Reactors, 1,000 gals.
1—Stainless Steel Storage Tank, 3'6"x4'.
1—Stainless Steel Storage Tank, 3100 gal. cap.
2—Pfaudler Glass-Lined, 500 gals., Horizontal Storage Tanks.
1—Pfaudler Glass-Lined, 300 gals., Storage Tank.
4—Glascote Glass-Lined, 200 & 300 gal. Storage Tanks.
1—Aluminum Storage Tank, 10,000 Gallons.
7—Rubber Lined Storage Tanks, 250 and 450 Gals.
1—Steel Storage Tank, 10,000 Gals., 1" Plate.
1—Plate Fabricated Jacketed Kettle, 900 Gal., 125 PSI.
1—Copper Jacketed Kettle, 6' x 6', with Agitator.
1—Buffalo Cast Iron Jacketed Kettle, 600 Gals., with Mixer.
1—Plate Fabricated Jacketed Kettle, 900 Gals., 125 PSI.
4—Glascote, Glass-Lined, Jacketed Kettles, 300 gals.
1—Pfaudler, Glass-Lined, Jacketed Kettle, 150 gals.
4—Stainless Steel Jacketed Kettles, 300 gals.
1—Stainless Steel Direct Fired Still, 6'x6', with coils and Agitator.
1—Blaw-Knox Jacketed Autoclave, 3'x4'2" with Agitator.
1—Patterson Jacketed Autoclave, 3'x3'9".
1—Buflovak Chrome Plated Double Drum Dryer, 32"x90", complete with Motor, speed reducer, and conveyor.
1—Buflovak Chrome Plated Double Drum Dryer, 32"x100", complete with Motor, speed reducer, and conveyor.
2—Buflovak Vacuum Drum Dryers, 24"x20".
2—Louisville Rotary Steam Tube Dryers, 6'x50'.
1—Louisville Experimental Stainless Steel Rotary Steam Tube Dryer, 12"x6'4".
2—Buffalo Double Door Vacuum Shelf Dryers, 12 & 15 Shelves.
2—Black & Clawson Double Drum Dryers, 28"x5'.
3—Buffalo Flakers, 5'x12'.
1—Ruggles Cole Direct Fired Kiln, 7'x80'.
1—Bartlett & Snow Direct Fired Kiln, 6½'x50'.
1—Farrel Masticator.
1—Lancaster Laboratory Muller.
1—Banbury Mixer #1 with 50 HP Motor.
4—Baker Perkins Jacketed Vacuum Type Double Arm Mixers, with Motors & Drives, 100 Gals.
1—Cavagnarro Vacuum Type Double-Arm Mixers, with Motors & Drives 100 Gals. cap., Stainless Steel.
2—Cavagnarro Steel Jacketed Mixers, Chromium Plated, interior double arm fishtail blades, 100 gals. cap., vacuum type with 40 HP Motor & Drives.
3—J. H. Day Double Arm Jacketed Mixers, 50 Gallons, Sigma blades.
1—Baker Perkins Double Arm Jacketed Mixer, 200 Gals., sigma blades.
3—Baker Perkins Double Arm Mixers, 200 gals. sigma blades.
1—Patterson, 5000 Gal. Turbo Mixer "New".
1—Patterson Nickel Lined Blender, 192 cu. ft. capacity with 20 HP Motor.
2—J. H. Day Mogul Type Mixers, 2½ and 5 Gals.

1—Shriver Filter Press, 42" x 42", 46 Chambers, side-feed, open-delivery, washing type.
1—Shriver Filter Press, 36" x 36", closed delivery, side-feed, 25 Chambers.
1—Sperry Filter Press, 24" x 24", closed delivery, washing type, 10 Chambers.
1—Sperry Filter Press, 42" x 42", Plate & Frame, open delivery, washing type, 29 Chambers.
1—Sperry 36" x 36" Recessed Type Filter, center feed, open delivery, 42 Haresite covered Plates.

5—Simpson #0 Intensive Mixers "New".
3—Day Pony Mixers, 5 and 20 Gals.
1—A T & M Suspended Type Centrifuge, 30" Stainless Steel, Perforated Basket.
10—Sharples Super Pressurite Centrifuges.
1—Sharples Super Pressurite Centrifuge, Stainless Steel Bowl, Model #16V.
1—Podbielniak Stainless Steel Centrifugal Extractor Model 6000.
1—Royle #1 Perfected Extruder, with heating unit.
1—Allis Chalmers Ball Mill, 5'8"x16', Silex Lined.
3—Hardinge Conical Ball Mills, 8'x30", 5'x22", 6'x22".
1—Abbe Engineering Silex Lined Pebble Mill, 6'x12'.
1—Ball Mill Stone Lined, 7'x9'.
3—Ball & Jewel Rotary Cutters, No. ½ and No. 2.
2—Orville Simpson #41, Rotex Screens.
2—Selectro enclosed Vibrating Screens, 18"x48" Chrome Plated.
1—J. H. Day #71 Ro-Ball Coller, Stainless Steel Screens.
1—Acme Stainless Steel Condenser, 100 sq. ft.
1—Struthers Wells Stainless Steel, Double Pass, Condenser, 310 sq. ft.
1—Struthers Wells Stainless Steel Double Pass Condenser, 370 sq. ft.
1—Mikro Pulverizer #4TH with 60 HP Motor.
1—Mikro Pulverizer #2TH with 15 HP Motor.
1—Mikro Stainless Steel Atomizer, #6 with 20 HP Motor.
1—Mikro Pulverizer #1SH with 3 HP Motor.
1—Acme, Stainless Steel Jacketed Vacuum Reactor with Agitator 100 gals.
1—Swenson-Walker Crystallizer, Rubber-Lined.
8—Swenson-Walker Jacketed Crystallizers, 2'x2'x20' Sections.
1—Stainless Steel Column, 18"x18'.
5—Ice Machines.

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24" x 20" Buflovak Vacuum Drum Dryer.
28" x 60" to 32" x 120" Double Drum Dryers.
3—70" x 40' Ruggles Coles S.S. Dryers.
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100 gal. S.S. Clad Jkt. Kettles, 30" x 52".
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CHEMICAL AND BACTERIOLOGICAL ANALYSIS

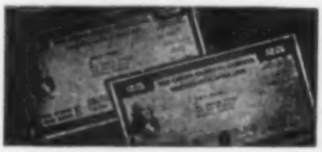
America finds a new, easy way to save

OUT of the war has come one blessing—a lesson in thrift for millions of those who never before had learned to save.

Enrolled under the Payroll Savings Plan in thousands of factories, offices, and stores, over 27 million American wage earners were purchasing "E" Bonds alone at the rate of about 6 billion dollars worth a year by the time V-J Day arrived.

With War Bond Savings automatically deducted from their wages every week, thrift was "painless" to those wage earners. At the end of the war, many who never before had bank accounts could scarcely believe the savings they held.

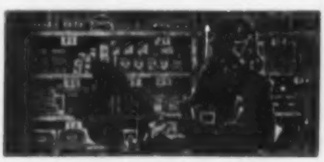
The moral was plain to most. Here was a new, easy way to save: one as well suited to the future as to the past. Result: Today, millions of Americans are continuing to buy, through their Payroll Savings Plan, not War Bonds, but their peacetime equivalent—*U. S. Savings Bonds.*



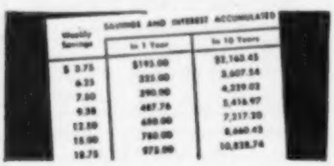
From war to peace! War Bonds are now known as U. S. Savings Bonds, bring the same high return—$25 for every $18.75 at maturity.

Out of pay—into nest eggs! A wage earner can choose his own figure, have it deducted regularly from earnings under Payroll Savings Plan.

New homes to own! Thousands of new homes, like this, will be partially paid for through Bonds wisely accumulated during the next five to ten years.



Keeping cost of living in check! Buying only needed plentiful goods and saving the money which would bid up prices of scarce goods keeps your cost of living from rising. Save *automatically—regularly.*



Savings chart. Plan above shows how even modest weekly savings can grow into big figures. Moral: Join your Payroll Savings Plan next payday.

SAVE THE *EASY* WAY... BUY *YOUR* BONDS THROUGH PAYROLL SAVINGS

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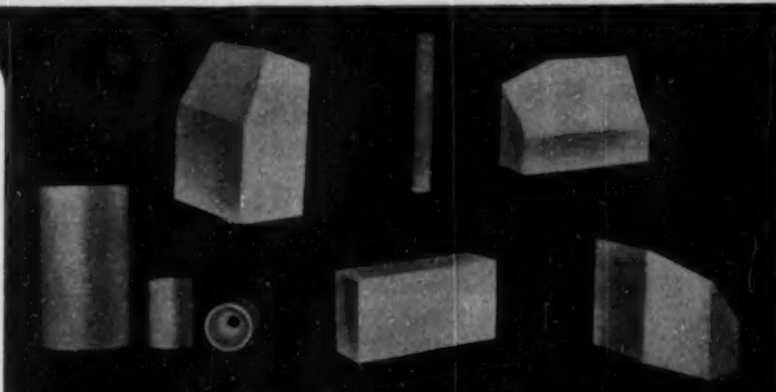
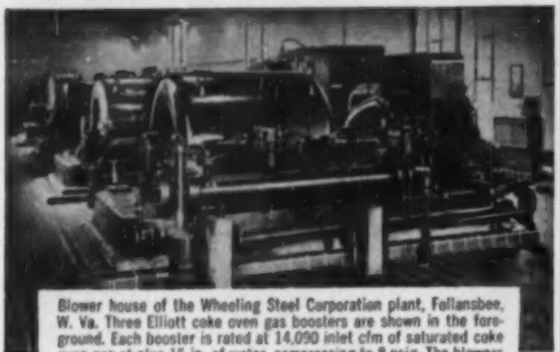

. . . in higher temperatures

Chemical recovery coke plants *favor*

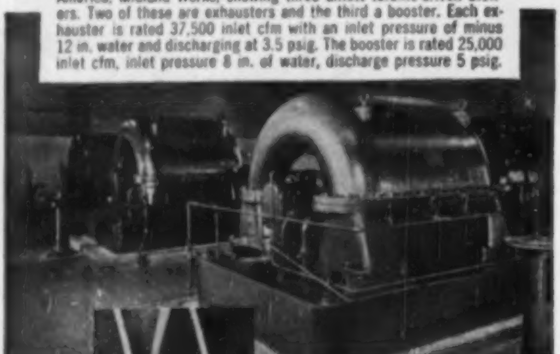
ELLIOTT *Centrifugal* BLOWERS



Blower house of the Wheeling Steel Corporation plant, Follansbee, W. Va. Three Elliott coke oven gas boosters are shown in the foreground. Each booster is rated at 14,090 inlet cfm of saturated coke oven gas at plus 15 in. of water, compressing to 8 psig. The blowers are driven by Elliott turbines, the automatically controlled speed maintaining constant discharge pressure.

•

Blower room of the coke oven plant of Crucible Steel Company of America, Midland Works, showing three Elliott turbine-driven blowers. Two of these are exhausters and the third a booster. Each exhauster is rated 37,500 inlet cfm with an inlet pressure of minus 12 in. water and discharging at 3.5 psig. The booster is rated 25,000 inlet cfm, inlet pressure 8 in. of water, discharge pressure 5 psig.



THE ELLIOTT WELDED IMPELLERS

are possible because of improved welding technique developed by Elliott engineers. All blade junction points are smooth fillets, eliminating corners or crevices where (as with riveted construction) dirt may collect and cause unbalance, loss of efficiency, and reduction in capacity; corrosive elements lodge and start attack; or erosion set in and destroy the blades.

In the modern coke plant, coke-oven gas, given off in the making of coke, is processed for the recovery of many valuable by-products such as tar, ammonium sulphate, pyridine, phenol, napthalene, light oil and finally fuel gas.

In moving the gas from oven to final process, Elliott centrifugal blowers are widely used, as both exhausters and boosters. This is a type of service for which Elliott blowers are particularly suitable because of the unique advantages in their welded impellers, free of corners or pockets in which tar and other viscous substances prevalent in the gas may lodge and cause unbalance.

The two modernized installations shown at the left are typical. In both cases, Elliott blowers replaced former reciprocating units.

Whatever you need for moving air or gases, check over Elliott blowers and the exceptional application experience behind them.

ELLIOTT COMPANY

P-101

Centrifugal Blower Dept., JEANNETTE, PA.

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ALL-METAL Master Speedrangers provide infinitely variable speed in an all-metal unit. This all-metal construction gives you greater compactness and durability than you can get from any other variable speed drive.

variable speed operation doesn't cost IT PAYS

SIMPLE COMPACT DESIGN The design is extremely simple, consisting of a metal ring which operates at a variable position on the two driving and two driven cones. The position of the ring on the cones determines the speed of the output shaft.

EXTREME FLEXIBILITY Speedrangers can be supplied for single phase, polyphase, or direct current operation. They can be furnished also with integrally built gear reduction units and electric brakes . . . in enclosed, splash proof, fan-cooled or explosion proof construction and for a wide variety of mounting arrangements.

HORSEPOWER Available in sizes up to and including 5 horsepower.

SPEED RANGES Up to 9 to 1 are available. (Up to 15 to 1 in some sizes.)

For additional information on how the Speedranger works and what it can do for you, write for Data 7525.

THE MASTER ELECTRIC COMPANY • DAYTON 1, OHIO